Engineering Library

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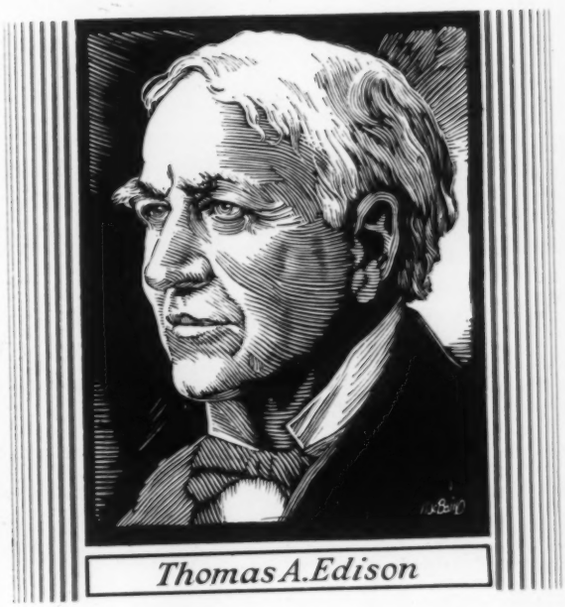
# MACHINE DESIGN



*Thomas A. Edison*

AS IT AFFECTS

## ENGINEERING—PRODUCTION—SALES

## MODERN MACHINERY CALLS FOR MODERN METALS

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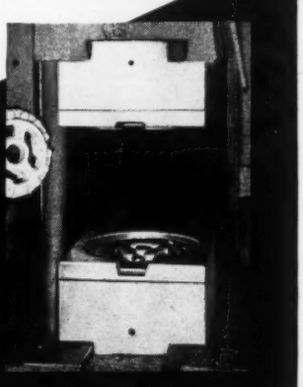

**NICKEL ALLOY STEEL**

Among the most widely applied materials in manufacturing are Nickel Alloy Steels. Pictured at the right is a set of Nickel Alloy Steel die blocks used by a prominent manufacturer of drop forgings. Nickel Alloy Steel is used because of its unusual strength and toughness and high resistance to shock.

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*Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column*

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ALL too frequently a design has been brought to a successful conclusion only to discover that inadvertant infringement of a previous patent necessitates either the payment of royalty fees or a complete redesign. A better understanding of patent protection and infringement may save considerable time and money. George V. Woodling will consider these problems from the angle of the designer in the August issue.

*Announcin*

# ANOTHER NEW G-E PRODUCT

GENERAL Electric announces two new low-speed packages of power — concentric- and right-angle-shaft fractional-horsepower gear-motors — two important power units that you will find highly profitable to consider in the design or redesign of your machines. Check these important features:

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GENERAL ELECTRIC

MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
July, 1933 Vol. 5—No. 7

# Vacuum, Inertia, Hydraulics Used in Automatic Controls

By Austin M. Wolf
*Automotive Consulting Engineer, New York*

*Fig. 1—A thermostatic coil varies the length of the entrance slot for liquid in this hydraulic shock absorber*

THERE has been steady progress in simplifying the control operations of motor vehicles. Complete automatic regulation is desirable and feasible in many instances, yet in other cases the will of the operator should be supreme and this cannot be supplanted by a mechanism. Automatic operation can be built into a machine tool where the cycle repetitions do not vary from day to day, but an automobile never can be made fully automatic since traffic and topographical conditions change continually. Furthermore, each driver has an individual technique which he would be unwilling to sacrifice to robot control and thus be denied some of the real pleasures of car performance.

The ideal control has been described as consisting of a steering wheel and a single lever which would govern the starting of the engine when not running; the forward progress of the car when moved in one direction beyond the "neutral" center; braking when returned toward center, the brakes being held "on" while at center; and reverse movement of the car when the lever is the other side of center. In this way engine starting, throttle, clutch, gear shifting and braking operations would be controlled by the lever. Other than the starting and gear shifting operations, such a control exists today. All adjustments or settings not concerned with control of direction and speed should be automatic, and great progress has been made in this direction. It is believed that a discussion of the various automobile controls will suggest possible applications in other fields of design.

The transmission is the unit that is now receiving the most intensive study. For many

years it remained unchanged. The advent of synchronizing gear and shaft speeds and the adoption of free wheeling opened up a new vision of possibilities. The trend at the moment is to retain the reverse and low speeds of the conventional transmission with manual control and to provide an automatic shift for second and third under the influence of speed. The Reo transmission, described on page 15 of the June MACHINE DESIGN, is of this type. Whereas this device utilizes a friction clutch under centrifugal control, another development under way incorporates an hydraulically controlled friction clutch with the liquid under the influence of a centrifugal governor and the position of the engine throttle.

### Outlines Early Devices

Automatic gear changing by centrifugal governor control is not new. Over twenty-five years ago it was incorporated in the Sturtevant car, but the state of the art at that time precluded its general adoption. All forward speeds were changed automatically. Such a system is not desirable as no governor is sensitive or quick enough to allow for parking or maneuvering in close quarters. Hence the desirability of a manually controlled reverse and first. To the highly skilled operator, automatic devices have a retarding effect. One can "get away" more quickly with full manual control than when depending on the automatic clutch, synchronized gear speeds or free wheeling. However, for the average driver such devices have improved driving ability and comfort.

With automatic gear shifting, it seems desirable to have a supplementary manual control which can be pressed into service when it is desired to suppress the automatic feature. This at first seems paradoxical, but consider a car negotiating a grade which the driver knows cannot be made in high. If full control is left to the automatic device, the car would have to slow down to ten miles per hour before it would act. With a supplementary control, second gear could be engaged manually at will and car momentum and fuel would be saved.

In the Mono-Drive, Fig. 5, a foot pedal is used so that second speed can be obtained as long as it is depressed. In this transmission first and second speeds are obtained through the left and right centrifugal clutches respectively within the flywheel drum. In the first speed the drive passes through a roller ratchet clutch to the central shaft. It then is conveyed to the small pinion meshing with the large gear located at the center of the countershaft cluster. A similar cluster is located on the opposite side and is supported, planetary fashion, in the carrier with the large helical gear. In mesh therewith is a transverse gear the shaft of which is provided with an overrunning clutch which prevents rotation of the planetary drum when power is applied. Power then is conveyed to a gear on the driven shaft by the right gear of the cluster thus making two speed reductions.

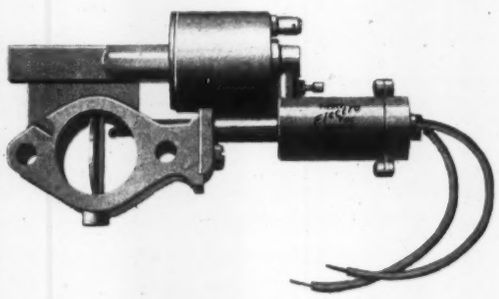

*Fig. 3—Butterfly valve on governor for speed control remains wide open until critical speed is reached*

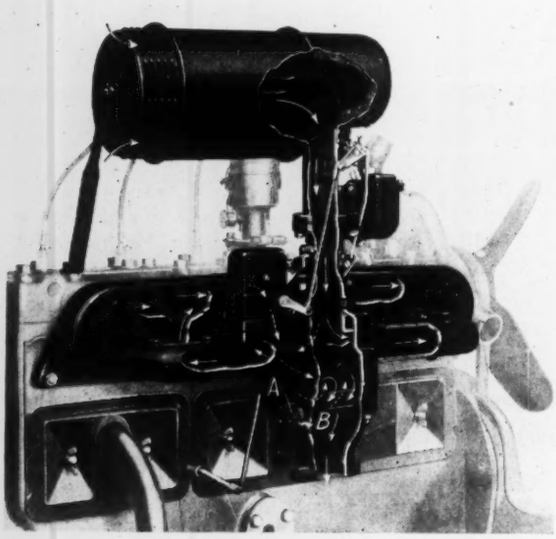


*Fig. 2—Automatic adjustment to the manifold controls sensitivity of automatic choke and fast-idle*

In second speed the right clutch at about ten miles per hour expands quickly instead of gradually and conveys power to the sleeve surrounding the central shaft and a gear on the right end meshing with the left cluster gear. The final reduction is thereafter as before. The central shaft is speeded up due to action of the large center cluster gear, but the roller ratchet clutch prevents any influence on the first speed clutch. If the foot is taken off the accelerator during second speed, the gear on the driven shaft becomes a driver, tending to speed up the already slowing-down engine. The reversal of forces on the planetary carrier allows its movement by the one-way clutch on the transverse shaft and a spring to the right of the large helical gear expands and locks the planetary carrier to the cup on the driven shaft, thus effecting direct drive. Reverse is obtained by means

of toothed clutches and the planetary gears.

It will be noted that no new driving means have been evolved. The developments have been restricted to control. We still are limited to definite gear ratios. Naturally we ask ourselves whether this is the ultimate. The infinitely variable ratio transmission is no doubt the final solution to the requirement of changing ratios. Various forms of hydraulic transmissions have been evolved but they are too costly, heavy and bulky. Without a gap in ratios, an automatic control would not be as essential as with present transmissions as we know them. Nevertheless it seems obvious that an automatic control is desirable, based on car speed or torque requirements or both. It also will be desirable to be able to supplement the automatic by manual control as previously outlined.

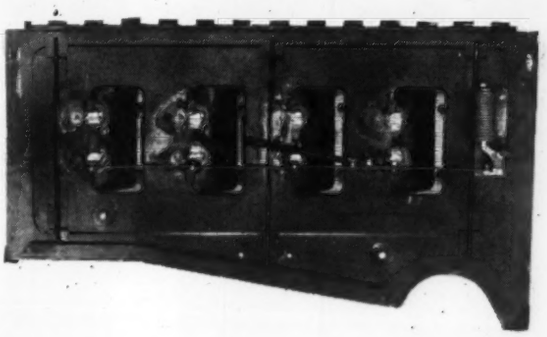

*Fig. 4.—Hood doors are connected to be operated in unison under the control of a thermostat*

The present day automobile is replete with automatic devices other than the gear changing mechanisms discussed. As in other fields, the evolution of relieving the operator of manifold duties has been going on for many years so that in reviewing the efforts to date we find automatic operation dependent upon such forces as speed, heat, inertia, fluid pressure and torque reaction. The field would be too large to cover every device that has been developed and therefore we will only refer to the more prominent ones.

For speed control in all branches of engineering, nothing is more prevalent than the centrifugal governor. It has been applied to the gasoline engine to prevent its over-speeding and was made sensitive to either engine or car speed. A problem in governor design was to prevent engine "hunting" and loss of power over the cut-off range. The latest effort in this direction is the Electro-Vac governor shown in Fig. 3 in which the butterfly valve remains wide open until the critical speed is reached. A special rotor having a hinged weight under spring restraint is placed in the ignition distributor. Contact is made at the governing speed and current is conveyed to the solenoid shown. A needle valve is opened, allowing manifold suction to enter the cylinder wherein lies a piston that actuates the butterfly through a rack and pinion.

### Eliminates Clutch Pedal

A centrifugally controlled clutch, known as the Powerflo was described in the January 1932 issue and in revised form is now standard equipment on several vehicles. Coupled with a free wheeling device, such a clutch eliminates the clutch pedal. Other designs are being developed and only the future will tell whether the so-called automatic transmissions or the centrifugal clutch with a conventional transmission will be in the ascendency. It is essential when employing a centrifugally operated clutch to provide a control whereby the clutch can be manually operated in the ordinary manner. This is necessary as in the case of cranking over an engine by pushing the car or to "lock" a car by parking it in gear. In either case the centrifugal clutch would be disengaged and a functional conversion is required. The several American designs have incorporated such a feature as a manual dash control or a vacuum device.

Thermostats play an important role in the automobile. Control of water circulation by Cadillac was one of the early endeavors. This resulted in quickly warming-up the engine when cold. A by-pass pipe to cut out the radiator was used but later designs merely provided a shut-off valve on the syphon bellows and the water was stagnant until the valve opened. Other makers placed shutters in front of the

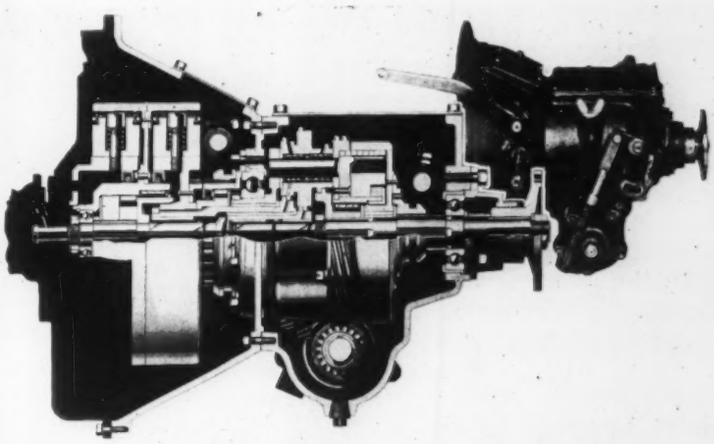

*Fig. 5—Manual operation is provided in connection with automatic gear shift*

radiator core, actuated by a bellows either in the radiator top-tank or in a header on the forward top side of the cylinder head. The latest vogue is away from the shutters and back to the by-pass.

Cadillac has used bimetallic strips for many years in its carburetors to control air vents and valve springs. The Bendix automatic choke and fast-idle, shown in Fig. 2 on the Oldsmobile six-cylinder engine, depends upon a thermostat adjacent to the exhaust manifold for its sensitivity. Actuation of the mechanism is accomplished by the suction in the intake manifold in conjunction with the thermostat *A*, in coil form, acting as a spring. The view also shows the flap valve *B* which deflects more or less of the exhaust gas on the intake hot-spot and the position of which is controlled by the thermostat at the left end of the valve shaft. Automatic control of this kind is rapidly supplanting the manual dash type.

Automatic control of the engine lubricating

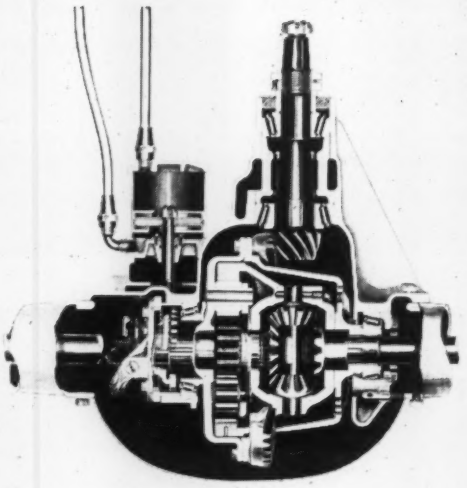

*Fig. 7—Vacuum is utilized for the shift in the dual-action axle*

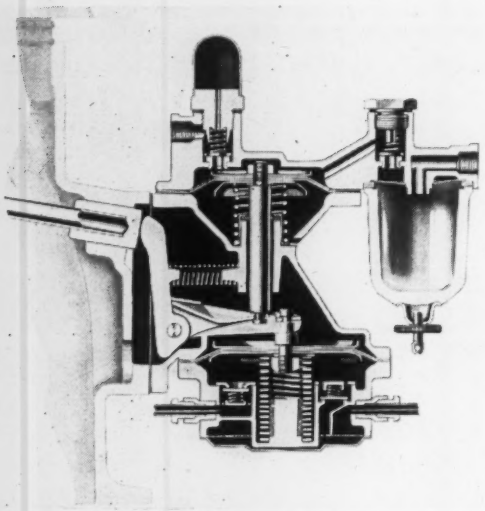

*Fig. 6—Pump goes into action whenever the manifold does not provide sufficient vacuum*

temperature is increasingly important in order to raise the oil temperature as quickly as possible when starting cold to insure adequate cylinder lubrication and to prevent too great a thinning of the oil during long sustained operation.

Stutz maintains an even under-the-hood temperature by placing a thermostat on the inside of each hood side and toward the rear where the heat "piles up" against the dash. Fig. 4 shows how the hood doors are connected to work in unison under the control of the thermostat when the motor becomes especially hot.

In the Monroe shock absorbers, an aluminum alloy piston is used with a thermal expansion three times as great as the cylinder it works in. The contraction of the piston aims by leakage to compensate for the viscosity increase of the shock absorber oil and a variation of less than eight per cent has been found over a temperature range of 100 degrees.

The various forms of torsional vibration dampers are excellent examples of the use of inertia to overcome excessive vibration of the crankshaft. The automatic vacuum clutch control has been improved greatly by the addition of the pendulum-operated cushion valve. Jerking of the car due to harsh clutch engagement is prevented by inertia of the rest of the pendulum.

Inertia control has been applied to the Delco shock absorber which was brought out to supplant the ride control of last year. A weight of approximately 1½ pounds is located at the rebound or left end of the unit, Fig. 10, and is supported on a spring of low rate. The weight

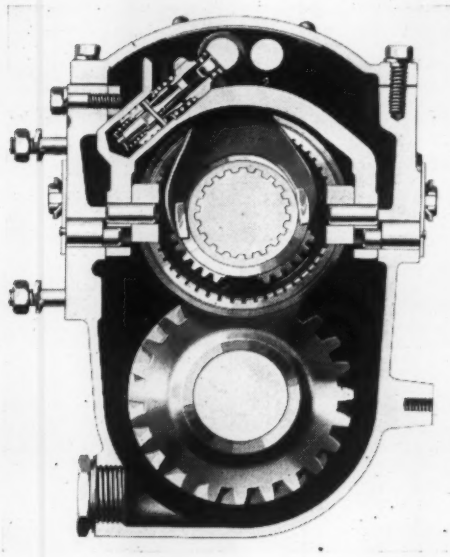

*Fig. 8—Device automatically compensates for viscosity changes in oils*

is secured to a sleeve which acts as a cuff valve over the orifice in the supporting stem. As long as the valve remains open, the shock absorber is free. An upward acceleration of the body and chassis due to meeting an obstruction in the road closes the valve and the added resistance thus brought into effect opposes the rebound of the car spring. Should a wheel drop into a rut, the axle will not pull down the frame since the inertia valve is not affected.

### Employing Fluid Pressures

Fluid pressure devices can be divided into those actuated by negative pressure, such as vacuum, and those acted upon by positive pressure—hydraulic or gaseous.

Engine vacuum has been harnessed to many uses. The vacuum tank was an early usage which has however been superseded by the mechanical fuel pump. The windshield wiper is another early example, the speed of oscillation of which

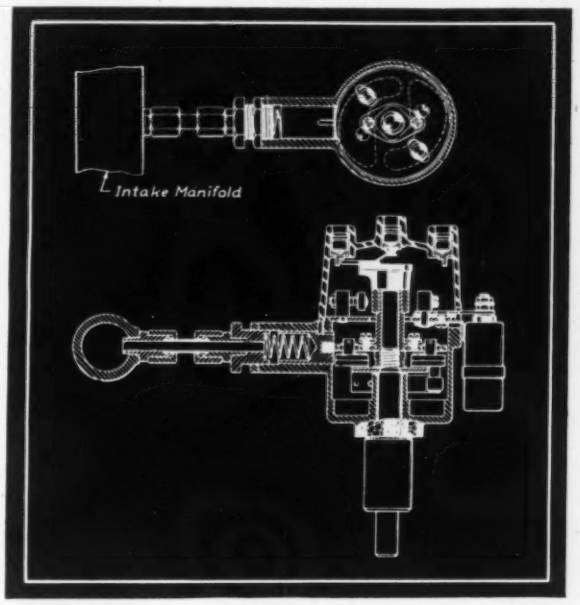


*Fig. 9—Spark control employs a pair of weights in co-operation with a supplementary vacuum device*

was, however, a distressing indication of relative intake manifold pressures. This difficulty has been overcome by the design depicted in Fig. 6 and is now used on most cars. The upper portion comprises the fuel pump while the vacuum pump is below. When the intake manifold does not provide sufficient vacuum the pump goes into action. With sufficient depression, the pump valves remain seated and no pumping action occurs. By this method the number of windshield strokes per minute is practically constant regardless of variation in the intake manifold pressures.

It has been found that spark advance or retard by centrifugal control is not sufficiently responsive to the wide variations of engine load and speed. Supplementary vacuum control is being used in several different forms. The Mallory system, in Fig. 9, utilizes a pair of weights with pins which, when they fly outwardly, advance a cam plate by engaging diagonal slots therein. A piston under the influence of a spring presses a brake shoe against the rim of the cam plate when the vacuum in the intake manifold is low and contracts the centrifugal governor, retarding the breaker cam and rotor. With a

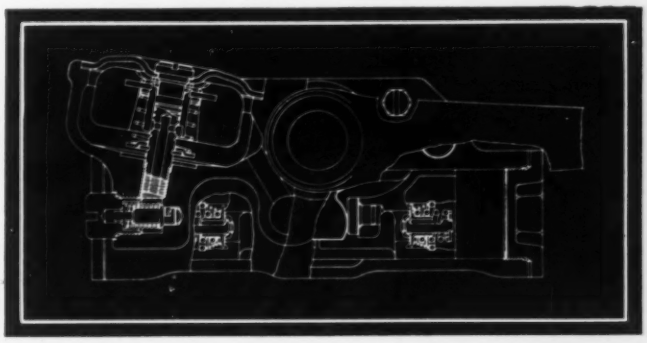

*Fig. 10—Inertia control is used to assist action for recently introduced shock absorber*

high vacuum the piston and brake shoe are withdrawn from the cam plate and the centrifugal advance comes into play unimpeded. The scheme is based on the premise that with low compression the mixture is much slower burning than with high compression and if the spark is not advanced further when the compression is low, loss of power will result.

The use of vacuum for the automatic clutch control and the booster brake are well known. In the latter, the braking operation is not automatic but the augmentation of power is. Vacuum is utilized for the shift in the Auburn dual-ratio axle of Fig. 7. Vacuum is admitted to one side of the piston shown and atmospheric pressure to the other. A bellcrank shifts a sleeve which when moved to the right locks all the gearing "solid" and the ratio of the bevel gears alone is effective. A movement to the left locks the sun gear of the planetary system so that it is stationary and an over-drive of the differential results. The automatic feature resides in the control. A preselection of ratio is possible by settling the dash lever to the anticipated position, whereupon the shift is made the next time the clutch pedal is depressed.

There will shortly appear a full automatic gear shifting and clutch actuating mechanism in which the entire speed control of the car is by means of the accelerator pedal. The act of shifting is practically imperceptible. The actuating medium is vacuum under the influence of

(*Concluded on Page* 59)

# SCANNING THE FIELD FOR IDEAS

*A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends*

## Rehabilitate with New Design!

NOW is the time for industry to focus a critical eye on equipment and methods The old order is changed. A new world with modern ideas no longer will respond to yesterday's modes and models. The railroads have worried along with the same type of equipment year after year, but are beginning to realize that something *must* be done. Passenger travel on the railroads of this country has been declining since the peak year of 1920.

That a new day is dawning for our railway systems is evidenced by the fact that the Union Pacific has placed an order for the construction of an entirely new type of passenger train, Fig. 1. High speed (110 miles per hour), light weight and full streamlining are features. Most encouraging is the fact that the interchange of ideas which this department is constantly striving to promote, will exercise an important influence in the design of this new train. It is based largely on automotive and aircraft developments.

Aluminum alloys have been selected to obtain light weight and strength. The train of three cars will not be over 80 tons, the weight of a present day conventional pullman sleeping car. In place of the underframe now used on passenger cars, which takes all the shock and in addition carries the superstructure and load, each car of this new design will be tubular in shape, the entire body forming a deep stiff beam requiring a minimum of material for a given strength.

Wind tunnel tests will determine the final contour. Computations indicate that proper streamlining will reduce the power requirement at 100 miles an hour to less than one-half that of the ordinary railway train. To attain the full benefit of streamlining windows of shatterproof glass, will be flush with the outside of the cars; vestibules between cars are to be covered to carry out the plan for reducing wind resistance. All devices such as headlights, tail lights, whistles, bells, etc., will be recessed in the body.

Further proof that the Union Pacific officials have left no stones unturned in their efforts to utilize all modern engineering developments lies in the selection of air conditioning. Windows will be sealed and forced ventilation employed to heat the train in winter, cool it in summer. Use of rubber, the sealed windows and probable installation of resilient wheels, will add to quiet operation. Modern indirect lighting is another feature. The three cars will be articulated, that is one truck will join each two cars.

Motive power is to be furnished by a 600 horsepower distilate burning internal combustion engine. Completion of the new train is expected in six months.

## Redesign Permits Dual Function

SOMETIMES it is possible by slight alteration in design and perhaps a change in position of parts, to accomplish additional purposes in the operation of certain machines. Designers of a well-known motion picture projector did that. By taking the shutter, which in the past has served only as a timing device to separate the projection of each frame, in front of the projection lens, changing its design somewhat and placing it at the rear of the machine between

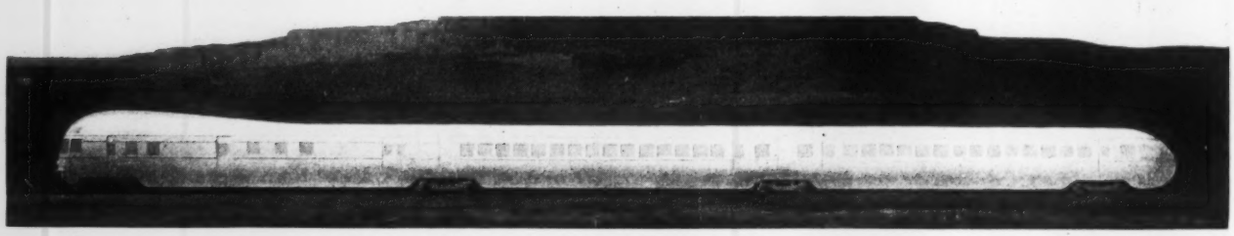

*Fig. 1—This Union Pacific high-speed, light weight, streamlined train is designed to rejuvenate railroading*

the arc light and the film, it has been possible to overcome a great deal of film buckling.

This vignette type rear shutter, Fig. 2, developed by International Projector Corp., New York, besides still being a timer, is in effect also

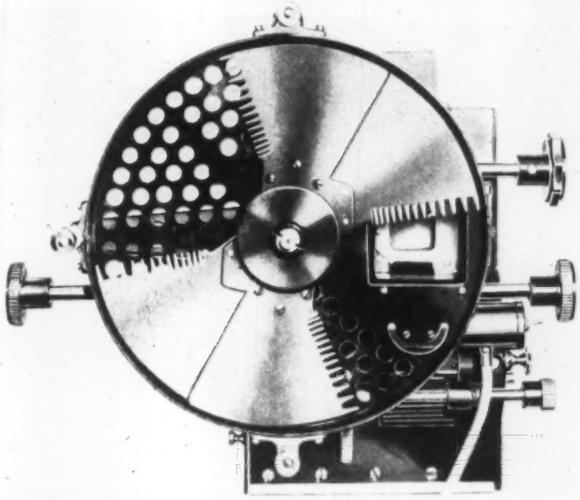

*Fig. 2—Vignette rear type shutter acts as fan to obviate buckling of motion picture film*

a fan. Buckling always has been an acute problem to the operator, and there is little doubt that the use of the high and low intensity lamp is a contributing cause. Many attempts hitherto have been made to reduce the heat of these powerful lamps but results have been unsatisfactory.

With the new device it is unnecessary to employ heat plates or shields in the proximity of the film. Advantage of running sound film particularly under cool aperature conditions is obvious. By placing this shutter between the lamp and the film instead of in front of the lens a strong blast of air is produced which holds the temperature at the film gate within a few degrees of that of the surrounding atmosphere. The shutter blades being of saw tooth design produce a dissolving effect on the motion picture screen.

Width of the rear shutter no longer depends on the size of the film so that with the new design a 90-degree effective blade can be used with a half size lens.

## Cradles Employed for Flexibility

USE of cradles on a new sheet leveler to obtain the desired distribution of pressure on the working rolls may suggest an idea to those designers who are confronted with similar problems in machines involving feeding, conveying or rolling units. By means of the triple cradle arrangement for the lower backing-up rolls, Fig. 3, these rolls align themselves more closely to the curve of the working rolls when deflected.

When pressure is desired on the middle of the sheet being leveled, the main cradles are raised and both the main cradles and auxiliary cradles undergo a tilting motion which causes the backing-up rolls to align themselves with the curve of the working rolls. If pressure is desired at the edges of the sheet, then the main cradles are lowered and they tilt with the auxiliary cradles in the opposite direction to that in which they tilt when pressure is applied against the working rolls. The upper backing-up rolls are held in a stationary plane. Sutton Engineering Co., Pittsburgh, developed the machine.

## Substituting Circuits for Drums

AN OUTSTANDING example of the application of electrical devices in design is found in the totalisator, a device for automatically calculating and displaying the amounts wagered on race courses. Arlington Park, Chicago, recently installed one. The machine was conceived by H. L. Straus, American Totalisator Co. Inc.

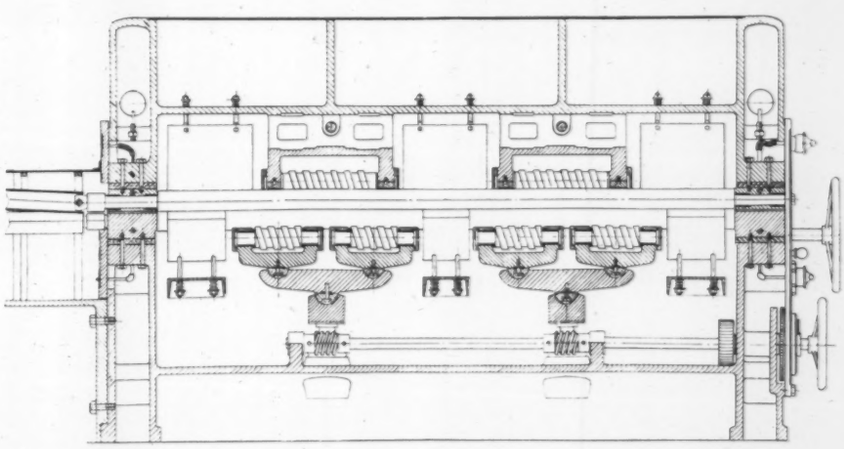

*Fig. 3—As described in adjacent column, the cradles of this sheet leveler facilitate alignment of backing-up rolls*

To the public it is a large display board covered with electric lights which form many combinations of figures. But behind the scenes are devices which mark it as a unique engineering

feat. Whereas other machines of this nature depend primarily on mechanical devices, Mr. Straus has employed electrical circuits to accomplish his purpose. In the early development mechanical devices, such as a series of drums after the manner of an automobile cyclometer, were tried without success, due to momentum carrying the numbers too far around. Then it was decided to attempt an illuminated digit which proved satisfactory after refinements were made.

It is not easy to display figures by electric lights in the face of bright sunlight. To overcome this difficulty each light bulb was surrounded with a white metal tube and the front screened with a copper mesh screen painted black. Natural amber lamps were used as these produced better results than any other color against a dark green background. A circuit has been developed whereby, through the use of standard telephone relays and rotary line switches, impulses originating at the ticket selling booths are picked up, assorted, added and displayed with great speed and accuracy.

## Reversed Refrigeration Gains

GREATER impetus has been given to air conditioning by marked progress in the development of apparatus employing the principle of the reversed refrigeration cycle which was discussed in these columns, April, 1932, page 26. Within the past month two prominent companies have

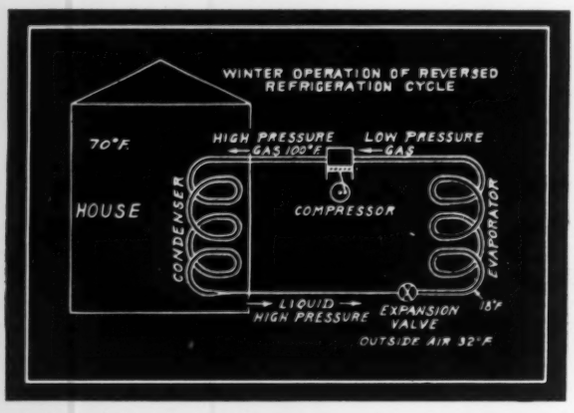


*Fig. 4—Schematic diagram of system employing principle of reversed refrigeration cycle*

demonstrated its practicability. In California, an application has been operating successfully for the past year (M. D., Dec., 1932, p. 21).

One company engaged in extensive investigation is Westinghouse. As explained by its engineers a reversed refrigerating plant can be understood more easily if its considered as a machine which pumps heat just as a water pump pumps water. Reversed refrigeration merely pumps heat into a space to raise the temperature in the space, as contrasted to straight refrigeration which takes heat out of a space to cool it.

Referring to the schematic diagram, Fig. 4, it will be more clearly understood how this system performs the function of a year-around unit, heating the home in winter and cooling it in summer. Vapor from the evaporator is compressed, thereby raising its temperature. Flowing through the condenser inside the house, the gas becomes a liquid and liberates the heat which is employed to warm the house during the cooler months. When it reaches the expansion valve the pressure of the liquid refrigerant is so reduced that it boils and in vaporizing makes the evaporator colder than the outside air. Heat flows from the warmer outside air to the refrigerant and the vapor again is drawn off by the compressor to repeat the cycle. In changing over the system so that the evaporator or cooling unit is inside the house (see Fig. 4) a valve arrangement is employed which changes the condenser into an evaporator. Benefiting by the experience of a test performed last year, Westinghouse is equipping a second house near its research laboratory with an improved system.

A self-contained air conditioning unit employing the new De La Vergne reversed refrigeration principle for warming and humidifying recently made its appearance commercially. To change it from a cooling to a heating unit requires only the turning of a lever. The device is housed in an attractive hardwood cabinet designed to harmonize with the surroundings of home, office, hotel, club or business establishment.

## New Material May Be Solution

IN ATTAINING increased refinement in design the engineer is depending on one of his most important allies . . . new materials. For example, when light alloy superseded gray iron as a material for pistons, it was discovered that its ring-belt section had a shorter life. To remedy this condition a new material was employed and the first ring groove was armored with a ring carrier of alloy cast iron, Fig. 5. The top drawing shows points of wear.

Development work on this innovation provides interesting data. As outlined by Dipl.-Ing. E. Mahle in a recent issue of *Automotive Industries*, it was found that any attempt to combine ordinary gray iron, with a coefficient of heat expansion of 0.000067 with light alloys having a coefficient of 0.000134 invited failure. To remedy this, he first made use of an aluminum silicon alloy with a heat expansion coefficient of 0.000010 which was armored with a ring carrier of an alloy iron with large nickel and copper content, 15 per cent nickel and 5 per cent copper, of about the same coefficient of expansion as the alumi-

num alloy. Later he successfuly armored aluminum copper piston alloys with an iron of even higher nickel and molybdenum or manganese content.

This construction resulted in increased life of cylinder bores, rings and ring grooves, as compared with gray iron or light alloy pistons. Ring carriers can be applied to different types of pistons including the trunk, split skirt and invar strut type.

Concurrent with the foregoing it is fitting to mention the comparatively recent development of inserted exhaust valve seats, consisting of a ring of special alloy welded to a steel ring

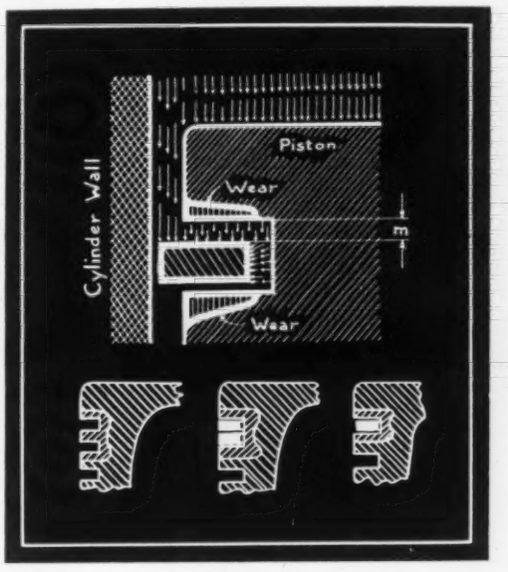


*Fig. 5—Nickel iron piston ring carriers solve wear and compression problem*

which is machined accurately, screwed and locked into the head. White Motor Co., Cleveland, among others, is employing this type of construction.

In the field of nonmetallic materials the development of an oilproof rubber is significant. According to Dr. L. W. White, Raybestos-Manhatten Inc., DuPrene, as it is known, has a high tensile strenth, excellent elongation, and good wear resistance. As to heat resistance, says Dr. White, it excels rubber; in fact this property alone may carve out an entire new field for the material, aside from its being solvent resistant.

Glass, says the *Industrial Bulletin* of Arthur D. Little Inc., has come to be the choice of design and development men in a growing number of widely different instances. A toughened glass made by a recent European process is said to withstand contact with molten lead at 620 degrees Fahr. without breaking, and to remain relatively tough even at relatively low temperatures. It is reported to have half the strength and twice the elasticity of steel. As a demonstration, a three-ton truck was driven upon a one-inch sheet of this glass, a cable passed about both, and the whole lifted high into the air by a crane. The glass bent under the load but did not break.

The foreging developments are indicative of vast opportunities which await those design engineers who give thought and study to the selection of new metallic and nonmetallic materials.

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## Packaging Machines Undergo Design Changes

TRENDS are changing in packaging as disclosed in a timely paper presented before the recent meeting of the American Management association in New York. H. H. Leonard, Consolidated Packaging Machinery Corp., Buffalo, N. Y., traced the transition brought about by changing conditions. It no longer is possible, for instance, to obtain the old type of ingenious mechanic who could fix and adjust almost anything, a condition which makes it necessary for the machinery builder to have his equipment completely designed with the object not only of simplified operation but simplified construction as well. Cost of producing the machinery also has become a factor and the machine builders now give fully as much attention to the use of a minimum of parts in the mechanism of their machines as they did formerly to their ingenuity. This not only has resulted in the lessening of the cost of the manufacture but has produced a better piece of equipment.

To impress on the purchaser the superiority of their product, manufacturers are producing packaging equipment which is better finished today than ever before, Mr. Leonard declared. Many either chromium or nickel plate the exposed parts and paint the balance of the unit with some of the modern paints that permit constant cleansing without affecting the finish.

These changed conditions and requirements also call for basic changes in the viewpoint of engineering departments. Inventive genius is the basic requirement of any good machinery designer and without it there would be little progress in mechanical matters. Coupled with that, however, must be a realization of the customer's requirements as affecting sales value together with cost and production adaptation. Sales value must be built into the machine.

Years ago the machine designer was required to possess only a knowledge of mechanisms and, with a certain degree of ingenuity, produce a mechanism that would perform an operation. Now he must have not only all of these qualifications but must acquire a fair knowledge of the process of manufacture in his customer's plant so that his finished machine will fit into the conditions as they exist.

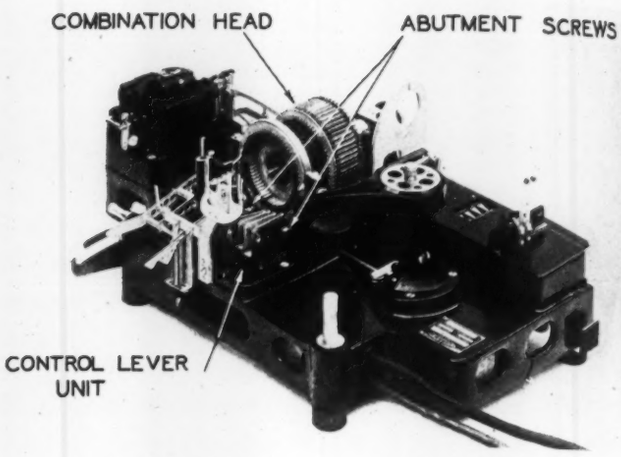



*Fig. 1 — Teleprinter, partly dismantled, reveals combination and control lever units*

# Unitized Design A
# Printing T

By R. D. Salmon

*Creed & Co. Ltd., Croydon, England*

UNTIL recent years telegraph instruments have been used solely by administrations or corporations and required frequent and skilled maintenance, but with the introduction of such machines into private offices where maintenance mechanics are not instantly available, it became necessary to produce a machine which required little maintenance, and to facilitate the rapid execution of such maintenance when required.

For this purpose the Creed teleprinter, described on page 11 of the June MACHINE DESIGN, has been built in small units that can be dismounted readily and exchanged for similar units in case of trouble. This principle was propounded by Mr. Adams in the article "Unitization—Logical Sequence to Interchangeability of Parts" on page 29 of the December, 1932, issue. It is possible to dismantle an operating teleprinter into separate units, replace any unit if necessary, reassemble the machine again and resume working in less than a quarter of an hour. This interchangeability is made possible by the provision of abutment or "mating" faces which provide accurate location between units, such faces bearing a fixed relation to the operating parts of each unit, and by the use of functional unit gages.

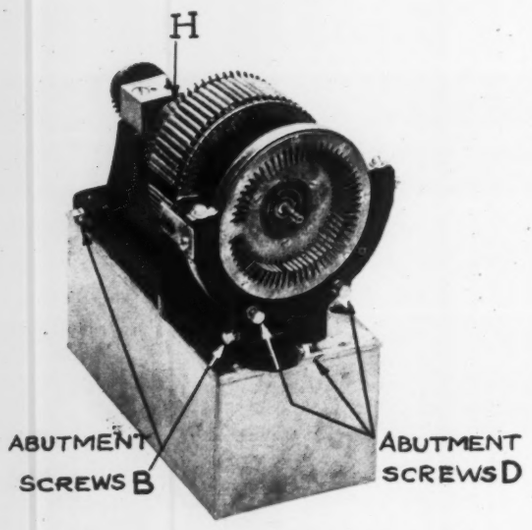



*Fig. 2—Combination unit mounted in its functional gage*

The teleprinter is the first machine to be built embodying these principles completely and it is the purpose of this article to show how these principles have worked out in practice, the requirements which had to be met, and the means of achieving the result required.

### How the Teleprinter Breaks Up

The machine breaks up into three main divisions, keyboard transmitter, receiving printer mechanism and paper carriage. The keyboard transmitter mechanism can be removed from the remainder of the machine by undoing two screws, driving and electrical connections being made by simple abutment surfaces and knife contacts. Mounted on a pivot, the paper carriage can be removed instantly by disengaging a single latch. The receiving printer mechanism divides up into eight smaller units, each unit being held to the base by not more than three

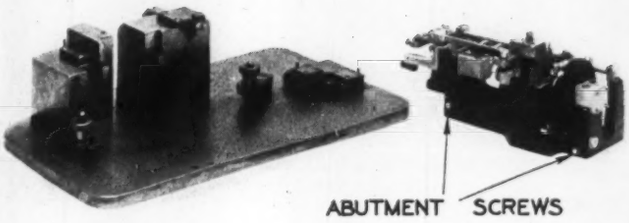



*Fig. 3—Cam unit, right, with the functional gage by which its mating surfaces are checked*

# As Applied to Telegraphs

and Arthur H. Adams
*Consulting Engineer, New York*

screws. Each unit is completely self-contained and can be removed readily.

In order to illustrate the principles of interchangeable unit construction, three units will be described in detail and their inter-relationships presented. These units are the control lever unit, the combination unit and the cam unit.

Fig. 1 shows the machine partly dismantled with the combination unit and the control lever unit in place, and two of the three abutment screws locating these two units can be seen. These two units are shown separately in Figs. 2 and 4, and the corresponding abutment screws on each unit are indicated. It should be noted that one of the abutment screws on the control lever unit is hidden behind the boss of one of the control levers.

In general, each unit must be located in three planes of motion, such as those between the control lever and the combination units. The first plane is fixed by setting both units down on a common base plate. Movement in the second plane is fixed by the two pairs of screws which face one another, and motion in the third plane is fixed by the single pair of screws at right angles to the first pair. These are shown in Fig. 6 for the three units to be described. In conjunction with the base plate, the screws determine the exact relationship between each pair of units as they touch one another. It thus is necessary to standardize the relation between the operating surfaces of each unit and its own abutment or "mating" surfaces.

### Adjusting the Control Lever Unit

In the case of the control lever unit and the combination unit the common operating features are the control levers $d_1$-$d_6$, shown in Fig. 4 and also in Fig. 5. These have to engage with corresponding levers $K_1$-$K_6$, Fig. 8, on the combination unit. These levers also can be seen projecting from the front plate in Fig. 2. It therefore is essential in the control lever unit to maintain accurate relationships between levers $d_1$-$d_6$ and the abutment screws. These relationships are shown in Fig. 5. The tolerances of all piece parts are such that when the unit is assembled the relationship limits shown can be achieved by proper adjustment of the abutment screws. The jig and gages shown in Fig. 7 are

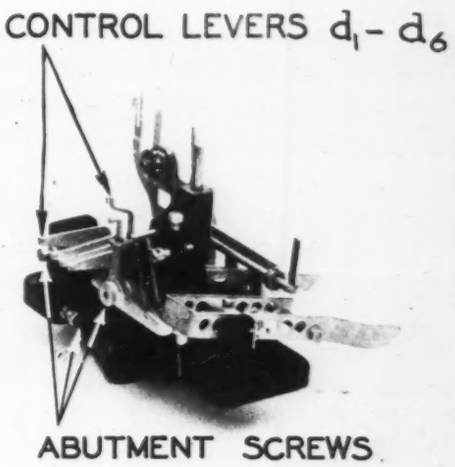
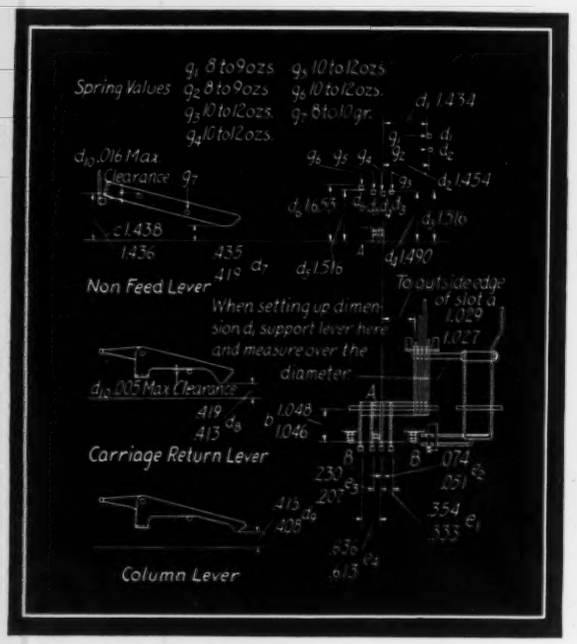



*Fig. 4—All vertical dimensions are given from the base to these control levers*

used for this purpose. A control lever unit is shown in place on the jib.

Referring again to Fig. 5, the six squares $d_1$-$d_6$ represent the ends of the control levers seen in Fig. 4. All vertical dimensions are given from the base and all other dimensions are given


Spring Values
Non Feed Lever
When setting up dimension $d_5$ support lever here and measure over the diameter
Carriage Return Lever
Column Lever
To outside edge of slot a
Clearance

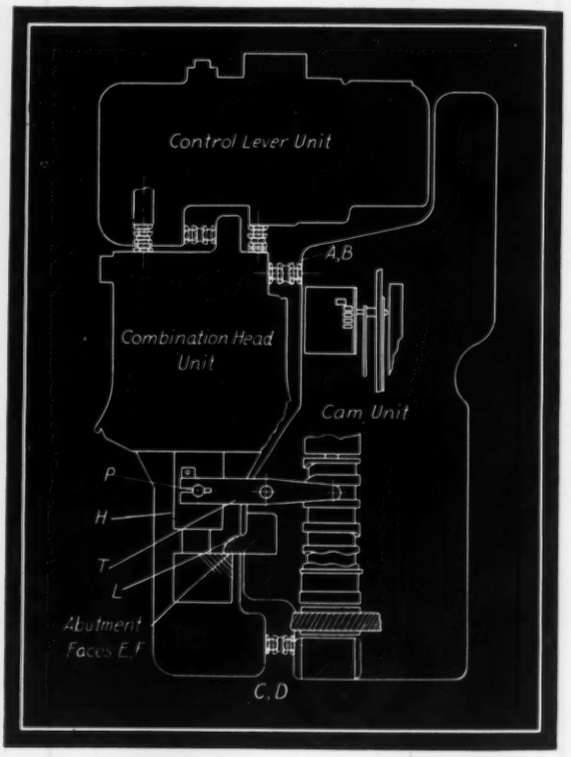



*Fig. 5—(Above)—Diagram of control lever unit.*
*Fig. 6—(Right)—Comparative arrangement of the co-operating units*

from one or the other of two planes at right angles which pass tangent to abutment screws $A$ and $B$ respectively. In order to adjust the abutment screws, the unit is first lightly clamped in the jig, placed on a surface plate, and turned so as to stand on face $P$, Fig. 7. It then is tapped into place so that the spindle $S$ is horizontal as measured by one of the swan neck gages. Next the clamping screws are tightened and the height of the abutment screws $B$ are adjusted by means of another swan neck gage. The jig is then turned into the position shown and the vertical height is adjusted, by moving the slide by means of screw $I$ so as to bring pin $Q$ to a definite height as measured by a third gage. The height of the abutment screws $A$ is adjusted to satisfy the fourth gage. The unit then is removed from the jig and the control levers added.

The complete unit is placed in the functional gage shown in Fig. 9. Dimensions $d_3$-$d_6$, Fig. 5 are fixed by slides $B_1$-$B_4$, Fig. 9, against which the control levers are held by their springs. Dimensions $d_1$-$d_2$ are fixed by slide $O$. Dimensions $d_7$-$d_9$ are checked by slides $D_1$, $D_2$ and $D_3$. Slides $D_1$, $D_2$ and $D_3$ are provided with "go" and "not-go" faces corresponding to the upper and lower limits shown against dimensions $d_7$-$d_9$, Fig. 5. When placing the unit in the gage the unit is held so as to press the abutment screws against faces $X$, $Y$ and $Z$, Fig. 9, before clamping it into position. If the dimensions $d_7$-$d_9$ cannot be satisfied, it indicates that some one or other of the component parts is not correct to drawing. It should of course be understood that individual piece parts are checked during the manufacture by means of gages in accordance with ordinary production methods.

### Combination Unit Adjustments Noted

Checking and adjusting of the combination unit is carried out in a similar manner in a functional gage. The abutment screws first have to be adjusted with respect to a keyway which is milled parallel to the axis of the spindle passing through the unit. This keyway locates upon two studs in the fixture and the abutment screws $B$, Fig. 8, are adjusted against the corresponding abutment faces on the fixture. Also the abutment screw $C$ is adjusted against the corresponding face on the fixture. The abutment screws $D$ are adjusted to satisfy dimension $d = 0.204$ inch max. 0.202 inch min. by means of a special slip gage.

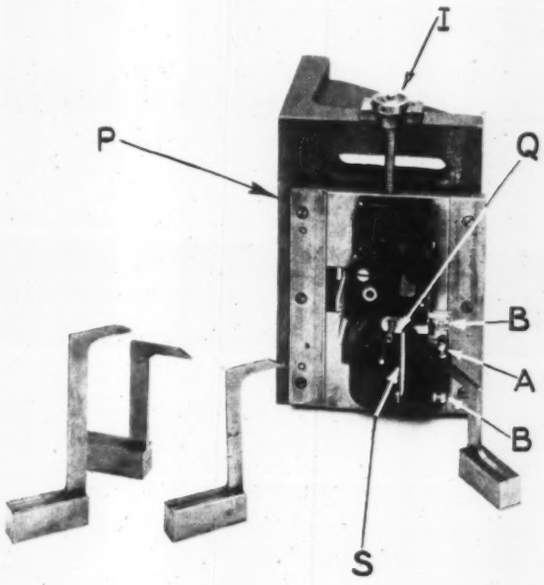
Six bellcranks, $K_1$-$K_6$ in Fig. 8, engage with the corresponding control levers on the control lever unit. It will be noticed that the slides $V$, $O$ and $B_1$-$B_4$, Fig. 9, are arranged so that the fixed dimensions $d_1$-$d_6$ in Fig. 5 correspond to the top

limit of dimensions $k_1$-$k_6$ in Fig. 8. Thus any variation in the position of the bellcranks in the combination unit within the limits shown, tends to depress the control levers and so elevate them at their outer ends. This is allowed for in the relationships between the control levers and the paper carriage. In Fig. 1 it will be noticed that the control levers are pulled down at their outer ends by springs so as to hold their inner ends against the corresponding bellcranks on the combination unit. Strength of these springs is checked with a spring balance by direct measurement on the ends of the levers that engage with the bellcranks, and the correct values are shown by arrows $g_1$-$g_7$, Fig. 5.

### Relation of Combination and Cam Units

The cam unit lies against the combination unit on the right-hand side as shown in Fig. 6. The two units as before are located in one plane by being situated upon a common base plate. Screws *A*, *B* and *C*, *D* keep the units at the correct distance apart and the relationship in the third plane of motion is in this case fixed by two nonadjustable abutment faces *E*, *F*.

Fig. 3 shows the cam unit with the functional

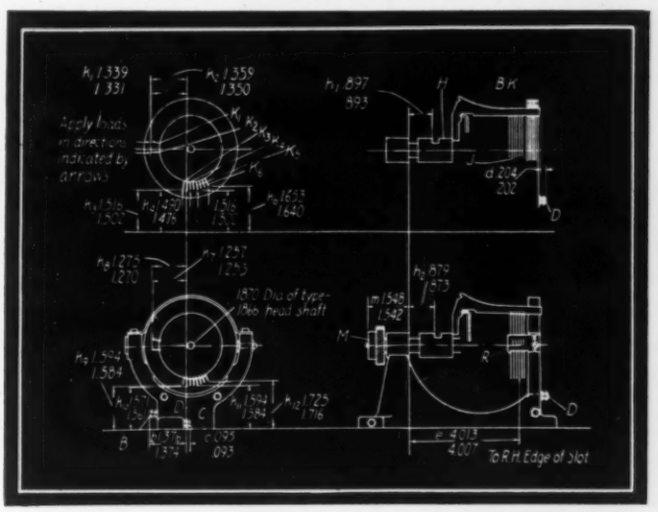



gage opposite to it. The abutment screws *A*, *B* and *C*, *D* can be seen in Figs. 2 and 3. Abutment screws on the cam unit are adjusted before placing the unit in the gage in a manner already described for the other two units.

Operating features relating the combination unit and the cam unit comprise the bellcrank lifting lever *I* Fig. 6 (see also Fig. 2, p. 11, M. D., June) and the bellcrank lifting collar *H* on the combination unit shown in Figs. 6 and 8. This combination unit comprises the selector disks *J*, Fig. 8, around which are arranged the 64 bellcranks *BK* (see also Fig. 6, M. D., June). Collar *H* has to lift these bellcranks to hold them clear of the disks by about 1/64-inch and to release them so as to allow them to fall on to the disks so that one or another can fall into an aligned set of slots about 1/16-inch deep. Collar *H* is moved in a direction parallel to the axis of the selector disks by the lever *I* on the cam unit and it therefore is necessary to arrange a definite relationship between these two parts when the units come together.

Selector disks *J* are provided with arms or extensions projecting through rack *R*, Fig. 8, which are engaged by the fingers on the cam unit. Therefore, a relationship must be maintained between these two parts also. The load on the bellcrank lifting collar *H* when lifting the 64 bellcranks *BK* against their springs, best shown in Fig. 2, is about 30 pounds; it is necessary to provide a rigid location between the cam unit and the combination unit. This has been done by dispensing with an adjustable abutment screw in one plane of motion and providing instead solid abutment faces *E*, *E*, between *F* lug *L* (see also Fig. 2 page 11, M. D., June) on the cam unit casting and the rear bearing on the com-

*Fig. 7—(Left)—Setting jig used for checking control lever unit. Fig. 8—(Below)—Permissible limits allowed for combination unit*




bination unit as shown in Fig. 6. This is indicated symbolically in Fig. 8 where the front of the rear bearing is shown as the base point for dimensions $h_1$-$h_2$ and $e$. It will be seen that all endways dimensions on both units are taken from this mating plane, that is to say, from the plane that passes through the faces *E*, *F* of lug *L* on the cam unit and rear bearing on the combination unit.

As the bellcranks have to be lifted an exact

amount, the positions of the bellcrank lifting collar, operated and nonoperated (dimensions $h_1$-$h_2$), must be correct to within $\pm$0.002-inch and $\pm$0.003-inch respectively. In order to avoid the necessity for a high degree of accuracy of the piece parts concerned, an adjustment has been provided in the form of an eccentric pin *P* on the end of bellcrank lifting lever *T*, Fig. 6, which can be rotated so as to vary the exact position of the trunnion on the bellcrank lifting lever. This adjustment, however, can be made instantly as soon as the two units are placed against one another.

While perhaps the reduction of field maintenance was the most cogent single reason for utilizing the teleprinter, and one amply justifying the decision, there are other advantages of almost equal importance that will be noted more frequently with lapse of time. As this successful machine evolves to meet changing conditions and new requirements there will be found increasing value in the ability to redesign it *by units*, whether to cheapen, improve, correct defects or add features, and to do this without having to render existing machines obsolete and without serious reaction on stocks of parts; in the ability to modernize all machines in use by merely exchanging a unit or two; in the keeping of stock by units; in the ability to produce quickly quite new and special machines from standard units plus a special one; and in the careful design and more analytical inspection that unitization entails.

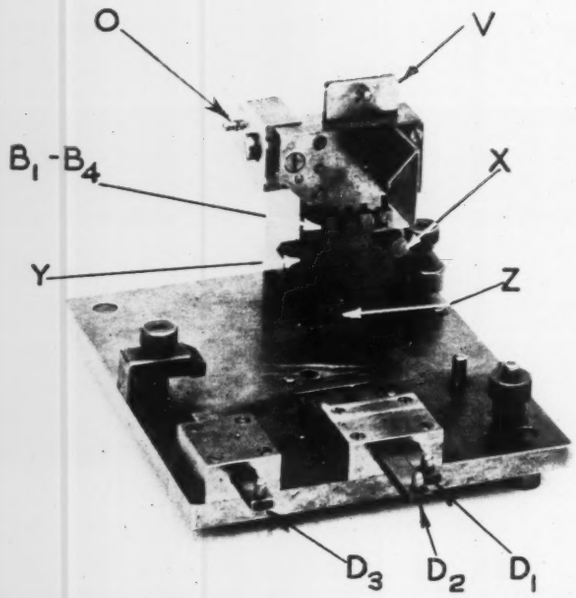



*Fig. 9—This functional gage is used in checking dimensions on the control lever unit*

# Inventors Should Train as Engineers

INVENTORS, often facetiously referred to as being exceedingly eccentric, require only the same important mental characteristics to be successful as do persons engaged in other businesses, although there are certain modifications of these characteristics necessary to enable good mechanical design, according to Prof. G. M. Bartlett of Purdue university who spoke recently at the meeting of the Society for the Promotion of Engineering Education. The important qualities of inventors listed by Prof. Bartlett are:

1. Originality-creative talent-resourcefulness
2. Imagination-ability to visualize and concentrate
3. Observation and curiosity
4. Perseverance-tenacity of purpose-patience
5. Intelligence and good judgment
6. Analytical ability
7. Mechanical ability
8. Self confidence and optimism
9. Knowledge and memory
10. Business ability

Both heredity and environment contribute in an important way toward the making of an inventor, but these characteristics are believed to be possessed to some extent by all persons of high intelligence, and are capable of being developed by special training. The inventive type, however, if he is to be outstanding as such, must be endowed at birth with natural aptitudes as suggested in this list so that he will be adaptable to favorable environmental influences including special training designed to develop his inventive abilities.

As the professional inventor of the future must have a good technical education, it is logical to choose the engineering school as the place to train inventors. It has been stated that the type of training given in technical schools at the present time tends to discourage rather than to encourage creative thinking; but since it is estimated that not more than two or three per cent of the students in these institutions are naturally creative, it should not be difficult to place these in special classes where originality is encouraged.

The solution of original problems in plane and solid geometry, an advanced course in descriptive geometry, a course in mechanism treated synthetically as well as analytically, and plenty of time spent on the solution of inventive problems would stimulate the inventive faculties of a properly selected group and could hardly fail to produce gratifying results for any future engineer whether he plans to invent or not.

# Considering Design from the Production Standpoint

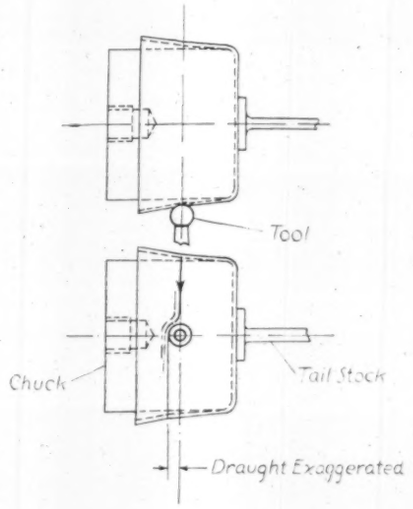



*Fig. 1—Material is gathered by the tool and then forced past*

By Harold F. Shepherd

## Part VIII—Hot and Cold Forming

MOST early hollow work was made by smithing. Where possible it was developed and bent, then riveted, welded or brazed. Envelopes in the form of spherical segments and their upset flanges were made by repeatedly "Wrinkling and razing." By this tedious process the edge of the plate metal blank was fluted to gather the excess metal in its circumference after which the corrugations were hammered out. It was necessary for this hammering of the fluted rim to cause lengthening or drawing without wasteful thickening or upsetting of the metal into the adjacent sections. Only the thicker sheets could buck up against this thrust.

Spinning and drawing have replaced this method in most crafts but the metal flow is much like that in wrinkling and razing, as indeed it must be. It is, however, orderly and continuous.

In spinning, the material is gathered by the ball nosed tool or rounded roll and then forced past with a resultant lateral or drawing movement rather than being forced under the point of contact, an action which would cause upsetting. This action is illustrated in Fig. 1. The objective is not the universal spreading of swaging or rolling but the undirectional drawing of the tubing mill rolls.

If the material is too thin or not sufficiently ductile, or if the bite of the tool is too broad or too deep, wrinkles develop or the job buckles and is ruined. The spinners art is to avoid this by skillful manipulation, by choice of materials and tools, and by annealing at stages.

Double acting drawing dies, Fig. 3*A*, accomplish the same object in a different manner. The blank holding element *a* exerts sufficient pressure to prevent the flange from wrinkling which will occur with great regularity in attempting to draw unconfined thin disks into cups. The undrawn material in the flange is thickened by lateral or self compression as the blank circumference grows less and is reduced again in the degree desired by drawing. If greater reduction or greater accuracy of the shell wall is required, drawing is supplemented by ironing in which the annulus between punch and die is restricted.

To avoid shearing and excessive bending stresses, fair radii at *b* and *c*, Fig. 3*A*, are essential. The element *a* is lacking in single action drawing dies used for heavy

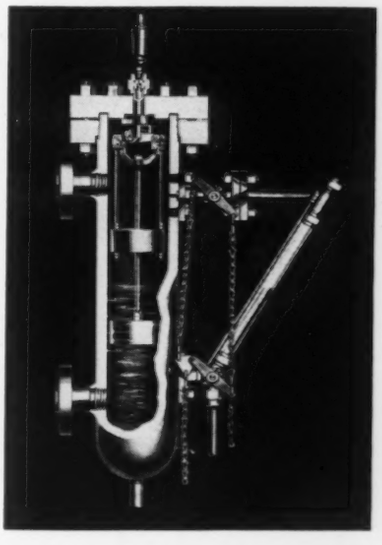


*Fig. 2—For high pressure water columns steel forgings are employed*

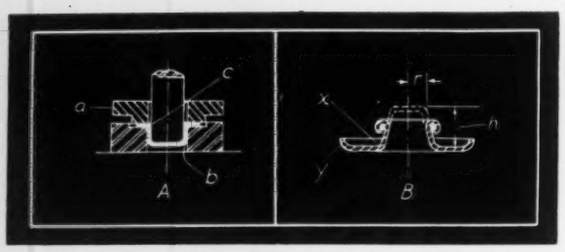



*Fig. 3—Double acting drawing dies are so constructed that flanges are prevented from wrinkling*

sheets. Flange stiffness and die ironing simulate the blank holder action.

Both the machine designer and the metal worker need to find common ground on one point before successful use of die formed parts under dynamic loads becomes universal. The question to ask of the metal worker is not, "Can you do it?" He can do almost anything with sheet metal. Rather it is, "How will you do do it?" and then the engineer experienced in the performance of metal under test should be able to judge the expediency of the process for his purpose. Heat treatment of cold formed sheet metal products working under stress is far more important than for hot forgings.

Fig. 3*B* shows a little job that got into history. These valve spring washers failed at $x$ and were replaced by parts made from bar stock. At first glance it might seem that a simple pointed punch could pierce the blank and being thrust through expand the adjacent metal into the form of the conical socket. But if $h = r$, there being no mass of metal, the edge at the center of the tubular projection theoreticaly would be drawn to a knife edge and the elongation at that point would be infinite. It is apparent that this method or any modification of it requiring more elongation and reduction of area than the material will stand in test is impossible.

### Severe Strains Introduced

Actually the socket was drawn as a cup to the dotted lines. The bottom was punched out, then the job was inverted and wired, the latter operation perhaps subjected the area at $x$ to severe compressive strain after it already had been drastically bent and drawn. It will be noted that this drawing of a small cup in the middle of a blank may be nearly as severe as a shell drawing job in which the reduction is excessive. The conditions are the same. Strictly viewed this detail is simply an uncompleted cupping operation.

In drawing rectangular shapes a great excess of metal is present in the corners of the blank as a development for folding to the same shape will show. Sharp corners are impossible and the depth limit for one draw is said to be four to six times the corner radius.

In the limits advised for cold drawing lie the key to economical design. A half inch on the height of a vessel may necessitate another die and another operation or reannealing. For the deeper shells where the advised reductions are by small stages it is especially important to collaborate with the die designers to avoid needless cost.

Often the relation between height and diameter are of no great moment to the designer. A volume may be contained in a larger diameter at less height. A cover may be increased slightly in diameter to reduce the relative height without harming general appearance. Increased metal thickness may permit a deeper single action draw. All of these are matters for consultation before the design is fixed.

Cold flanging of tubular objects is an expensive special operation and the flange width may not exceed 10 per cent of the shell diameter but

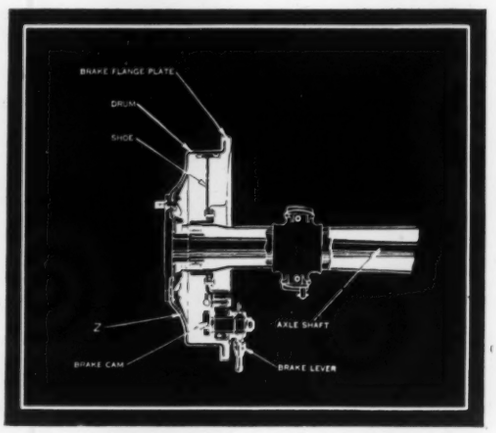



*Fig. 4—Die drawn jobs can be improved by a stamping or drawing operation on the web*

the flanged shell is a natural product of drawing. The drawing press operation may be much faster if the stock is punched through as the flanged job must be removed from the top of the die, this often requiring a swinging die plate since an available short stroke press may not retract the punch far enough to permit withdrawal of the work between punch and die.

However, the punched through job will require trimming. This may be done speedily on a lathe but as a press operation it requires costly tools since the unspecialized drawing press cannot act horizontally. The job may be put on a horn and sheared in three or four cuts or it may be dropped into the patent die which has three knives actuated horizontally by wedges attached to the press ram.

It does not always pay to trim and flange, wire, false wire or otherwise reinforce the lip when stiffness is required. It may be better to leave the flange on since trimming then can be done by a simple punch and die which may be

part of the final drawing die and if further stiffness is required these same tools may be made to strike the edge as at $y$ in Fig. 3$B$, now a characteristic finish for pans and covers packed with cork gaskets.

Cold spinning whether by hand tool on light sheets or by rolling has certain advantages in producing rotating vessels. The web on the bottom of the drawn job being little worked and certainly not as much worked as the flange may be in a state of indifferent equilibrium like the bottom of the squirt can. The spinner, however, is able to set up almost any desired condition by drawing the entire surface. The die-drawn job may be improved for such purposes by a stamping or drawing operation on the web as Fig. 4 at $Z$.

The limitations in spinning are much the same as those in drawing although perhaps less well defined as much depends on individual skill.

Extrusion has come forward to vie with spinning and drawing. It may be profitable to use aluminum shells made by this process, although it is not well adapted to the production of shells in steel. A powerful press is required as compared to the machine used for drawing, but the work may be done in a single operation regardless of relative height. It is said that extruded shells are always worthy of consideration when the ratio $h/d$ exceeds 1.5.

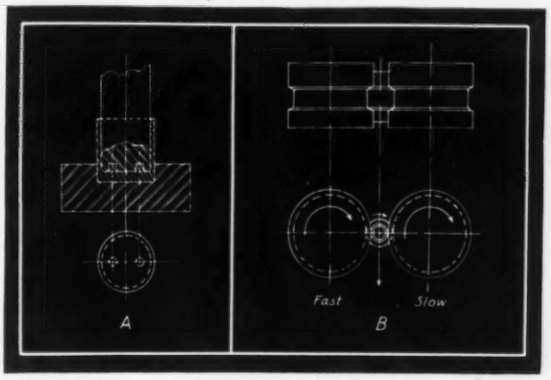



*Fig. 5—A. One-piece parts such as this are now practical. B.—Cold roll necking uses two formed rolls*

Special advantages are that rectangular shells with square corners may be produced and the inside radius at the head may be quite small. And while embossing or coining of the closed end of a drawn shell is not to be undertaken without thought, it may be accomplished at little extra die cost and no extra production cost in extrusion. The punch rams home at any rate although this is avoided or minimized in drawing and stamping if possible to make use of lighter and less costly presses. Lugs, studs or bosses are represented by depressons sunk in punch or die faces which are filled with metal while extrusion is in progress. Thus once totally impractical one-piece jobs such as Fig. 5$A$ are now possible.

Drawing and extrusion are limited to vessels with parallel walls. Bulging is required to make pot like forms. Usually such forms should be avoided, but they are essential in some dairy machinery. Large vessels are bulged easily by spinning into a form with a roll. In this work engineers feel that the ordinary figure of "elongation in two inches" is the measure of ductility since the tool action is more concentrated, as in necking in the testing machine. Cold bulges possible with one anneal range up to 30 per cent. Other methods of bulging include expanding punches of steel or rubber and hydraulic pressure. These latter two methods require confining dies for the job to prevent unsymmetrical or uncontrolled bulging.

The making of wheel blanks by hot rolling is a familiar process but it is not generally known that the process cannot be applied to small jobs. The Schoen mill, for instance, is designed to work on wheels 26 inches diameter and larger.

It will be apparent that the relation between conductivity of machine parts and the heat capacity of small blanks would be such as to cause rapid reduction of job temperature and perhaps severe machine over-heating which could not be corrected by the usual water jets without exaggerating the first evil.

### Cold Rolled Forming Introduced

Consequently, cold roll forming has been introduced for making small wheels of aluminum, steel and other metals. The operation Fig. 6$a$ combines slitting and bending. Anyone familiar with the common roller pipe cutter will realize that the slitting operation involves no great amount of pressure or power as the freely revolving cutter is advanced toward the job arbor a few thousandths of an inch at a turn. Spreading to form the angle of the sheave is a mild bending operation.

Successive operations may be employed to form the flange further in which case it is better formed during the slitting operation to some

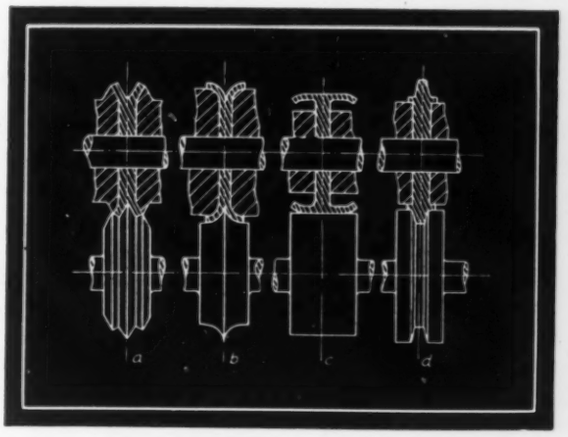



*Fig. 6—Successive operations may be employed to form the flange further and secure better parts*

angle more favorable for subsequent bending. Such an operation is shown in Fig. 6*b*, and *c* shows the next step.

The designer may judge the possibilities of working his materials in this way by their properties in cold bendng tests of like sections.

The operation Fig. 6*b* is more severe yet it has been carried out on a 2 per cent nickel steel. The radial elements are compressed to about one-fourth of their original height which perhaps is nearly the limit for steel in any single operation of this kind. The limit will be shown by flaking of the metal when all the slip lanes are used up but it is advisable to section jobs of this sort where the service is hard and check

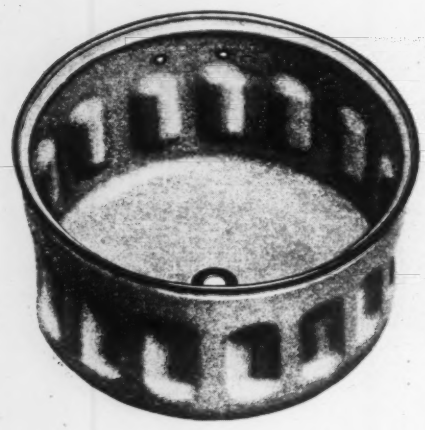


*Fig. 7—Flutes increase the circumference of the tub in their plane by ten inches*

them for structure by microphotography. The results need not condemn the job as slight changes in design, heat treatment or substitution of another material should insure success.

Cold necking must be carried out in small stages of 8 to 17 per cent reduction with frequent anneals. Thin metal may be spun in. Heavy metal may be necked by swaging. The operation should be attempted only as a definite production objective in which costs and advantages are given due weight. It is said to be rather impractical for steel of more than 20 C.

Cold roll necking using two formed rolls operating at different speeds to determine the rate of passing, as in Fig. 5*B*, is an ingenious development of much promise. It is said to antedate centerless grinding and the principle controlling feed and speed is somewhat the same.

Cold roll forming by which a single roll is forced against a revolving blank also is used to form articles similar to shells. Here the principle is entirely different from that used in sheet metal spinning in which any attempt to operate over a broad line simply distorts the shell and perhaps causes spreading of the metal rather than upsetting. In roll forming, controlled spreading against or along a rigid arbor and job web is exactly what is sought, conditions which must be established by design of job and tool.

Heavy shells often are forged hot by piercing, cupping or spinning as described briefly in the article on Forging, second of this series (M. D. Jan.) All of these hot processes produce uniformly pressure-tight vessels while boring from solid rolled billets does not, the porosity of the central relatively unworked portion allowing much leakage at the heads.

None of these methods produces finished work. The product is black, perhaps somewhat scaled and not quite so accurate dimensionally, but while cold forming is limited to extremely ductile metals such as 0.05 to 0.10 C steel, a broader choice is available for hot working and many alloys ferrous and nonferrous may be worked.

Hot necking is usually done by swaging. Shells or tubes of the gage of standard iron pipe and particularly that of extra heavy pipe will swedge in hammer dies in far fewer passes than when cold worked. The heaing also ties up less material and equipment than the slower between operations anneal.

### Special Rolls Required

Machines are available for hot flanging of shells but special rolls are required and it may be well to evade the forged-on flange which was done cleverly in the forged high pressure water column Fig. 2.

Stamping may be mere bending, or it may include stretching in which the sheet is prevented from sliding or drawing by the edge form of the die. It may include drawing as well. A close estimate of the severity of stamping operations is made by comparing the surface area of that part of the blank actually used with the surface area of the product.

In regular forms mere comparison of linear extension may be sufficient. Thus the maker of Fig. 7 states that there are fifteen flutes around the circumference of this tub which is 21⅞ inches diameter and that the flutes increase the circumference of the tub in their plane 10 inches.

Stampings always should be symmetrical so as to draw as uniformly as possible. If not, it may be necessary to make them in pairs and shear apart in order to get a gripping edge for the blank holder all around.

Beaded edges in stamped covers have a distinct process value in that they afford a grip while the sheet is being stretched and thus help to eliminate elastic recovery of small work.

The illustration used as Fig. 2 showing a Yarway water column was supplied through the courtesy of Yarnall-Waring Co., Philadelphia.

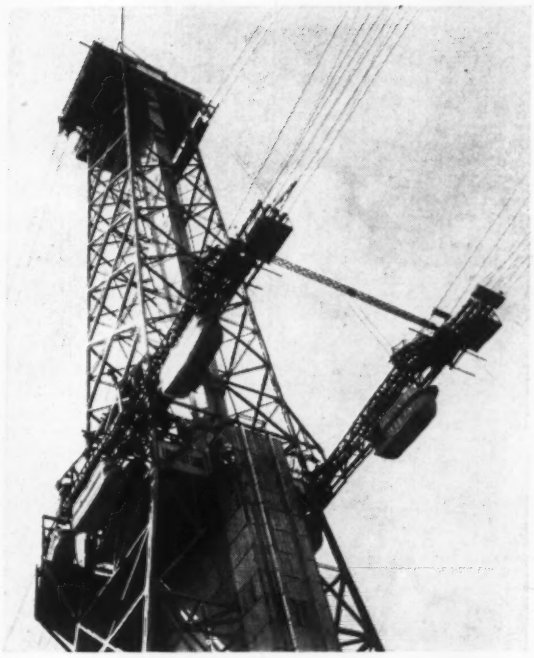


*Fig. 1—Cars of Sky Ride pass around observation towers at two hundred-foot level*

# Sky Ride Cars Have Pendulum Suspension

SUSPENDED at a height of more than 200 feet in the air, the Sky Ride affords visitors to A Century of Progress an excellent means of observation, besides a thrill. Designed and built by some of the leading fabricators of bridges, elevators, steel and foundations in the country, the structure straddles the lagoon at the northern end of the exposition grounds. On clear days four states are visible from its towers, rising 628 feet above the ground.

Ten rocket cars, each weighing 6200 pounds and capable of carrying 36 passengers, traverse the distance of 1850 feet between towers. Two or three cars usually can be seen crossing at intervals on each of the two lanes of cables from which they hang, the other cars passing around the towers for subsequent trips. Maximum speed of the cars approaches six miles per hour.

As will be seen from accompanying illustrations, the cars are suspended in pendulum fashion from short shafts passing through the driving truck. Each truck, built from electric steel castings, is equipped with four sets of wheels or sheaves, the outer sets of wheels being spaced at different centers to the inner to provide traction in passing over joints and to minimize unevenness of travel. The rear wheels are driven, during the time the cars are riding on the steel track around the towers, by a three horsepower high torque motor. When the car passes from track to cable suspension, however, the motor is cut out by the pilot in the car and clutch fingers operated by a thrustor and toggle joints grip a traction cable which travels at uniform speed from tower to tower and draws the cars across. As a safety measure, cam surfaces throw the toggle joint over in case the clutch has failed to grip up to this point.

For stopping the cars at the unloading point a mechanical brake assists the reverse torque of the motor which again is utilized for driving

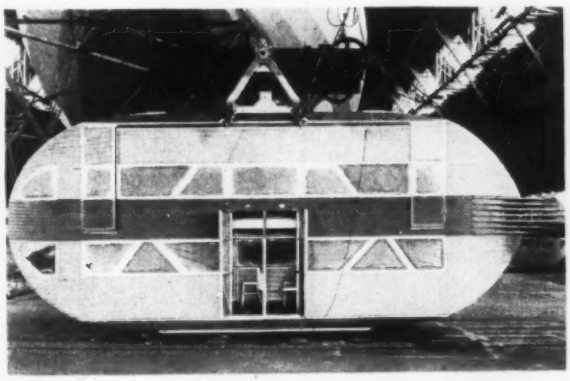


*Fig. 3—Car is suspended from center of driving truck and is allowed to tilt slightly*

when the car reaches the steel track extending from the tower as seen in Fig. 3.

Weight of the passengers is distributed over the upper and lower decks of the cars to prevent excessive tilting. Welded steel construction is used for frame, aluminum for outer plates.

A brief resume of the exposition proper only can be given to assist those who later may make the three or four-day trip (desirable minimum) to Chicago, also to give others a general idea as to the scope of the fair.

GENERAL EXHIBITS BUILDINGS: Five in number. Featuring general products, methods of manufacture, engineering materials and parts for embodiment in design of machines; original Gutenberg press; plants in operation, etc.

HALL OF SCIENCE: Adjoining general exhibits buildings. Devoted to scientific developments in fields of physics, mathematics, medicine, surgery, etc. Though some exhibits are not of pertinent interest from an engineering standpoint, many others are worthy of study.

TRAVEL AND TRANSPORT BUILDING: Featuring progress in all forms of transportation for past 100 years. Original locomotive, built in 1831 and loaned by Smithsonian institute, may be compared with modern high-power engines. "Miss America IX" is there with many exhibits of more recently developed boats. Airplane, steamship, automobile travel also are covered.

AUTOMOTIVE GROUP: General Motors, Chrysler and Nash have separate buildings. In former is one of the most popular exhibits of the show —a Chevrolet assembly line in full operation. Two diesel engines of welded steel construction are displayed that are of particular interest to designers, as are the ball and roller bearing exhibits and other displays, besides cars.

ELECTRICAL BUILDING: Here again, complete machines and electrical devices of all descriptions are shown. A striking feature is the "House of Magic" in which a lecture and demonstration are given at brief intervals on most interesting recent developments in electrical research.

COMMUNICATION GROUP: One display shows what happens when a dial telephone is used; another features telephonic research. There also is a complete unit producing radio lamps. Across from this group is the Thomas A. Edison memorial building. Experiments and inventions of this genius are aptly displayed.

AGRICULTURAL AND DAIRY GROUP: Featuring a range of agricultural equipment from cotton picker to grain harvester. Dairy industry exhibits include operating machinery.

SUGGESTED ROUTE: If first visit is in evening, best way to obtain overall idea as to layout is to travel across lagoon on Sky Ride and later, when lights are on to take trip on sight-seeing motor boat. All elaborate lighting effects can be enjoyed also on these rides. Buildings could be visited on subsequent days in sequence given above. Use of motor buses is recommended.

Individual company's exhibits of particular interest to designers are:

Ahlberg Bearing Co.
Alemite Corp.
Aluminum Co. of America
American Telephone & Telegraph Co.
Bakelite Corp.
Bausch & Lomb Co.
Borg-Warner Corp.
Bristol-Myers Co.
Carnegie Steel Co.
Century Electric Co.
Chrysler Sales Corp.
Copper & Brass Research Association
Cuneo Press, Inc.
Cutler-Hammer Co.
Le Laval Steam Turbine
Dietzgen Co., Eugene
Dow Chemical Co.
Duriron Co.
Fansteel Products Co.
Firestone Tire & Rubber
General Electric Co.
General Motors
General Steel Castings
Hoover Co.
Illinois Steel Co.
International Business Machines Co.
International Harvester
International Nickel
Iron Fireman Manufacturing Co.
Johansson, C. E. Inc.
Keuffel & Esser Co.
Kraft Phoenix Cheese Corp.
Link Belt Co.
Metal & Thermit Co.
New Departure Mfg. Co.
New Jersey Zinc Co.
Olsen, Tinius Testing Machine Co.
Phoenix Hosiery Co.
Revere Copper & Brass,
Singer Mfg. Co.
Taylor Instrument Co.
Texas Co.
Timken Roller Bearing Co.
Union Carbide and Carbon Corp.
Union Switch and Signal Co.
Westinghouse Electric & Mfg. Co.
White, S. S., Dental Manufacturing Co.
Winton Engine Corp.

Many other companies, such as Ford Motor, Viking Pump, etc., are featuring special exhibits in their Chicago branches and agencies.

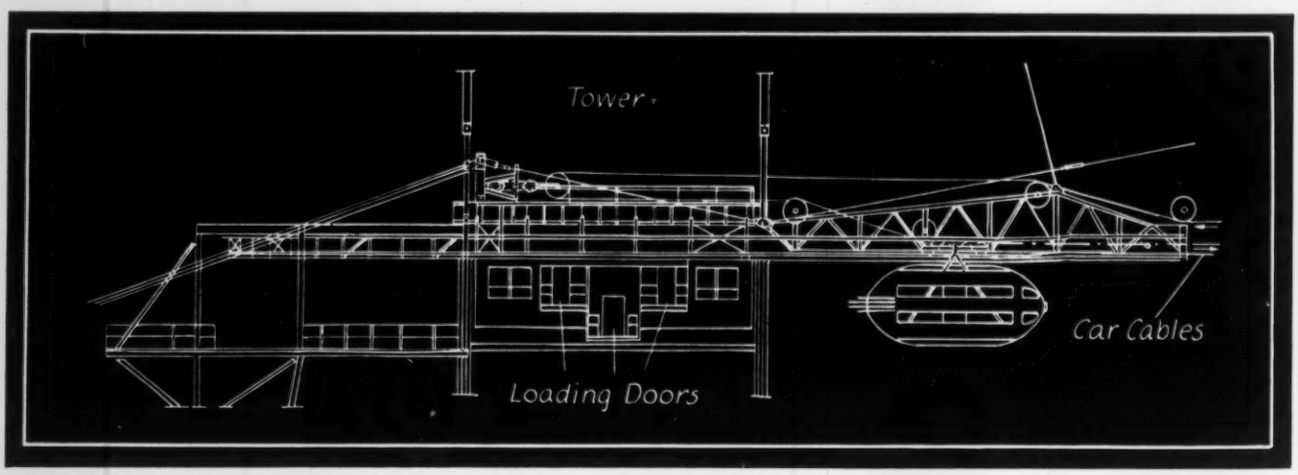
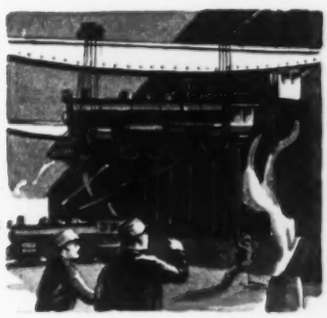



*Fig. 3—Elevation of tower shows car about to leave steel track and pass on to cables*

# Machine Creates Added Leisure, Wealth and Culture



WHEN pattern shops begin to show increased activity it's a good sign that machinery manufacturing is off to a new start. And that is what is happening now. As revealed by the survey published on page 30 of the April issue of MACHINE DESIGN, development work did not drop off in past years as low as production. Until recently, however, new designs were slow in reaching the production stage.

With the arrival of new forms of machines and mechanisms will come the age-old cry that the machine is disintegrating civilization, undermining our culture and individualism and converting mankind into an automation and a slave. For several months, however, while our financial structure was being examined, machine age criticism enjoyed a respite. The public began to realize that there were other factors in our social and economic system to be taken into account.

### National Income, Wealth Increased

To those who might hold any grudge against the machine for his plight, an address on "What the Machine Is Doing to Mankind," by Dr. James S. Thomas, Commonwealth & Southern Corporation of New York, is recommended. Before a recent meeting of the Franklin institute he fortified the proof that the machine is the very basis of our modern economic world. Making free use of the machine the United States has experienced the most progressive century and a half in the history of mankind. From 1779 to 1929, Mr. Thomas revealed, we increased our national income from $400,000,000 to over $80,000,000,000, our national wealth from approximately $500,000,000 to something like $375,000,000,000. The population in the meantime has grown from 3,000,000 to 120,000,000.

In developing his argument he set forth that the critics of the machine and our industrialism will say that this merely is materialistic progress and may mean nothing in the cultural life of the nation. But, he continues, that is exactly what it does mean. It has created the wealth and provided the leisure for our cultural advance. These critics should remember that idealistic cultures always flourish in those periods when people have made the greatest materialistic advance. There is good evidence for believing that the various "Golden Ages" in fine arts were not so much the result of literary revolts as the revolts of the well-to-do against the dead, dry, traditional cultures born of poverty and incrusted in form and ceremonial. The Italian Renaissance was bought and paid for by business men who discovered the art of converting raw materials into finished products and shipping them out to the peoples of the world.

Answering the accusation that there is nothing human in the machine, Mr. Thomas declared that the machine is the most humane thing yet contrived by man, and has far outstripped his philosophy or his altruism in freeing man from arduous toil and slavery. Aristotle accepted human slavery as did our own forebears. The altruism of the Christian religion, with the challenge of its master that all men are brothers constantly ringing in their ears for centuries, complacently accepted human slavery and waited until the machine made the system economically impossible before "rising up to strike off the shackles" of human slavery.

Time was not so long ago when 16 hours was a legal day's work. The machine has made this inhumane. Altruism never freed slaves. Where

(*Concluded on Page* 58)

# MACHINE DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

## National Recovery Act May Create New Trends in Design

EVERY individual holding a responsible position in the machinery industries should become familiar with the provisions of the national industrial recovery act. In it are possibilities for changing many important functions of industry.

Executive officers of machinery manufacturing concerns will study its effect upon competition, its influence on labor relations and its net result in terms of income and expense. Operating officials will watch the interpretation of its provisions for shorter hours and higher wages. Sales managers will be interested in its attempt to curtail price chiseling and in the possibility that under certain conditions minimum prices may be established and business allocated. Purchasing agents will try to anticipate its effect upon the prices of materials, parts and supplies.

Engineers and others charged with responsibility for machine design may find difficulty in visualizing, especially in the early stages of the life of the new law, how it can affect design. Nevertheless they should be alert to sense significant changes.

For instance, in certain industries the substitution of three six-hour shifts for two eight-hour shifts may necessitate alterations in production machinery. Certainly if the "stretch out" system in the cotton textile industry is banned, as suggested in the first hearing, fundamental changes in the design of certain textile machinery will follow.

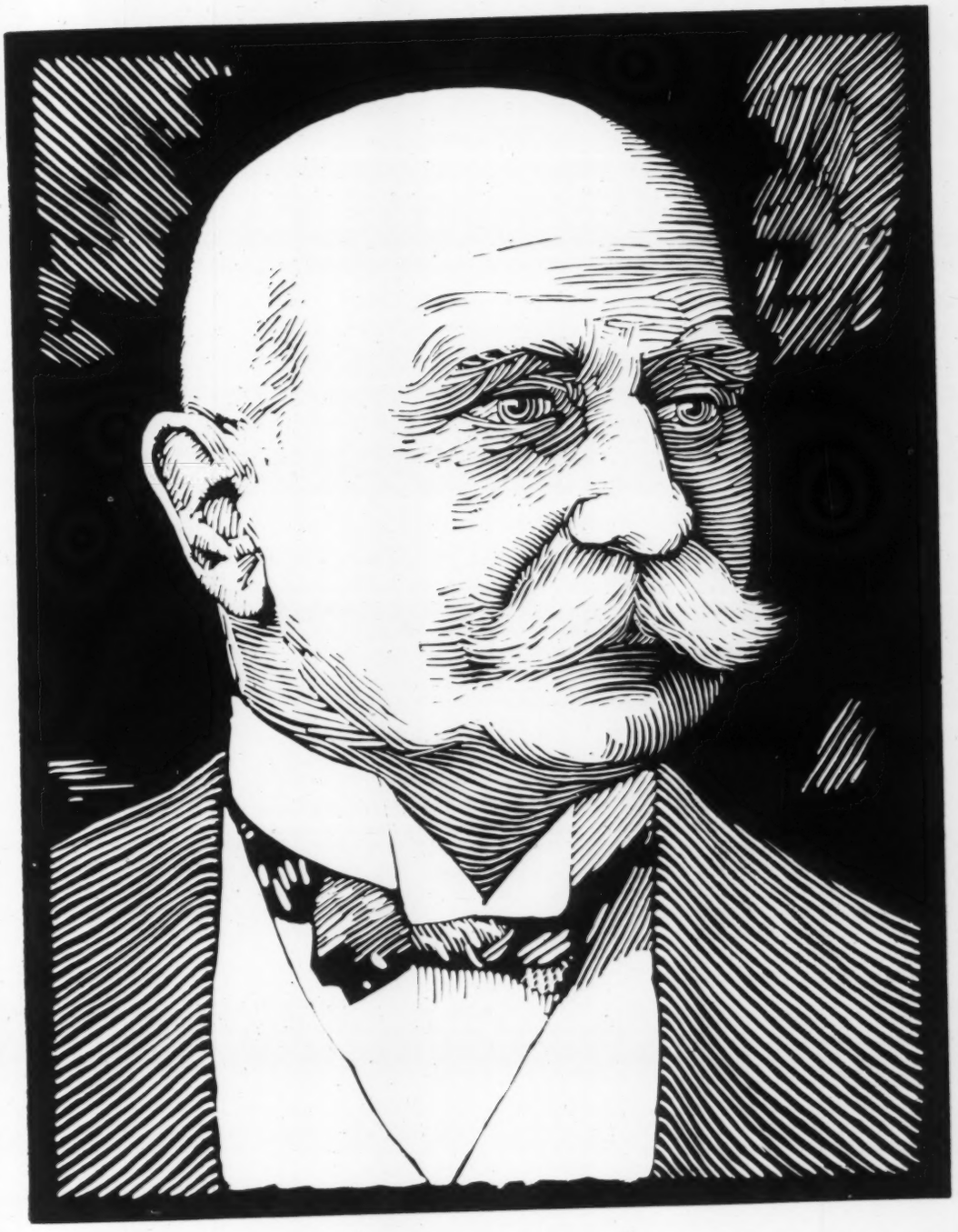
So many other similar situations are possible under the provisions of the new law that engineers will do well to watch developments closely.

• • •

## A Source for Ideas

WITH "A Century of Progress" well under way, engineers living some distance from Chicago are asking "Should I make the trip?" Varied reports are being relayed by earlier visitors, each being apt to view the exposition from his own standpoint. Expressions range from "A glorified carnival" to "Best show of its kind ever held!"

It safely may be said that those who look upon this exposition as a form of carnival have failed to take in the full range of exhibits. There naturally is the usual section devoted to amusements, stunts, etc. But for engineers on the alert for new design ideas in employment of materials, parts, processes, etc., the Fair holds great promise. Though not by any means a machinery exposition, much can be learned also from the exhibits that include operating machines and model plants—even from the design of the unique buildings and structures.



*Ferdinand von Zeppelin*

# *Master Designers*

## Ferdinand von Zeppelin

RARELY has the fate of an invention hinged so much on chance as did the development of the rigid airship by Count Ferdinand von Zeppelin. Had not his desire for adventure brought him to this country where he made a solo balloon flight, and had he not been prematurely retired from the German army through the rumored inadvertance of defeating the Kaiser's pet troops at maneuvers, it is doubtful if he even would have studied rigid airships to any great extent, let alone design them.

BORN of a well-to-do family which for centuries had expected and attained achievement and distinction, at Lake Constance, Germany, in 1838, Zeppelin early distinguished himself as a fearless man who could keep his head under stress and one who loved stunts. Routine army life into which he naturally gravitated was too dull for him. Scorning tradition and the amazement of his friends, "the crazy Count" was transferred from the infantry to an engineering school where he received the basis for his technical work on the airship.

ARMY life was the principal forte of this adventurer, however, and he returned to take part in several wars, always distinguishing himself and earning many coveted medals. Retired at 52, Zeppelin found a great deal of time to devote to the study of airships, a subject which had intrigued him since his first flight. Semi-rigid ships had been flown by the French while an American had flown the channel in a similar vessel, but Zeppelin poured his private fortune and talents into the construction of an entirely rigid dirigible.

WRECKS, disappointments and lack of finances delayed success. The government was loath to help, delaying until after several dirigibles built through popular subscription had succeeded. Zeppelin then found himself a national hero. He lived to experience the personal satisfaction of a job well done and world-wide acclaim, dying in 1917 after having developed airships which were the ultimate for military observation, a field in which he never lost interest.

# PROFESSIONAL VIEWPOINTS

*Publication of letters does not necessarily imply that* MACHINE DESIGN *supports the views expressed*

*Comments and Questions from Our Readers. Machine Design Welcomes Letters or Solutions to Problems Suitable for Publication*

## Obtaining Intermittent Movement

*To the Editor:*

IT OCCURS to me that the interesting mechanism described herewith might be of general interest to readers of your magazine, and so I am submitting it for possible publication.

One of two slides of a package wrapping machine—one slide being superimposed upon the other—is given an intermittent movement. The stroke of the intermittent slide is shorter than the other. As shown in the accompanying illustration, both slides *b* and *c* are given reciprocating movement by the oscillating lever *d* which is connected to the upper slide *c* by the pin *n*.

On arm *e* cast integral with slide *c* is mounted a shaft to which is pinned the four-lobed cam *g* and the ratchet wheel *f*. Both of these members with their shaft are free to turn in the bearing on the arm. The ratchet wheel engages pawl *h* pivoted on the part *l* which in turn is secured to the stationary frame.

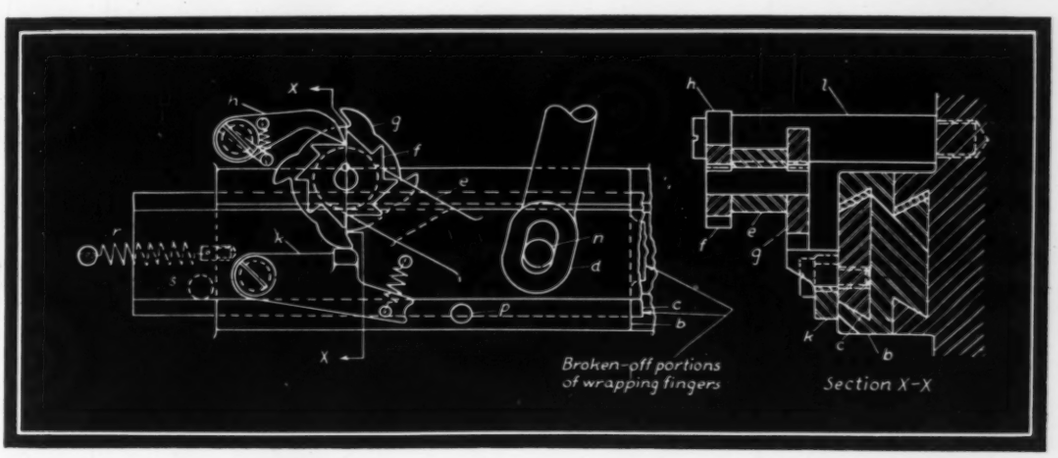
Cam *g* engages the latch *k* pivoted to slide *c* and this latch in turn engages stop pin *p* in slide *b*. The movement, toward the left, of slide *b*, is imparted, by means of the tension spring *r* and limited by the bumper pin *s* in the stationary frame.

In the position shown, the levers and slides have reached the end of their movement toward the left. It will be noted that the pawl *h* in engaging the ratchet wheel has rotated the cam into position so that one of the lobes have forced the latch outward. With the latch in this position the movement of the lever and slide *c* toward the right will cause the end of the latch to engage the pin *p* and force slide *b* also toward the right. Both slides thus travel together until this stroke is finished.

On the return of lever *d*, slide *c* is carried back together with slide *b*, the movement of the latter being imparted by the tension spring *r*. The simultaneous return movement of both slides continues until the lower slide comes into contact with the pin *s* at which time this slide commences its dwell.

Continuing the movement of slide *c* toward the left, pawl *h* engages the ratchet wheel and rotates the cam one-eighth of a revolution. This places the cam in position so that the lug on latch *k* moves inward between the two adjacent lobes. At this point the levers and slide *c* have reached the end of the stroke.

Now as slide *c* moves toward the right, the end of the latch will not engage pin *p* but clear it. Thus slide *b* will continue to dwell for the remainder of the stroke and also for the return stroke. At the end of the latter stroke the engagement of the pawl with the ratchet wheel will move the succeeding cam lobe into position




*One of two slides, superimposed one on top of the other, is given an intermittent motion by unique mechanism*

to force the latch outward so that it will pick up and carry along slide *b*.

Thus it is evident that slide *c* has a continuous reciprocating movement. Slide *c* however is not only dwelled one stroke-cycle after each cycle of slide *c*, but is given a shorter stroke with this arrangement. This shorter stroke was necessary to position the wrapping fingers (not shown) attached to slide *c*.

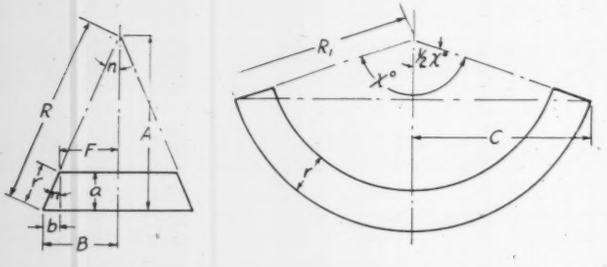
By spacing the lobes on cam *g* in a manner other than shown, this mechanism may be applied where the dwell is required to occur irregularly rather than uniformly as shown.

—E. F. EBERHARD,
*Bridgeport, Conn.*

## Computing Conical Sections

*To the Editor*:

HAVING experienced that wasteful task of making a layout of a part in order to determine the size of sheet or amount of material required for the bill-of-material or like purposes, I believe that the plan for calculating the following problem will be of interest to other designers. In developing a right cone or the frustrum of a right cone it is evident that the entire problem is dependent on the slant height, *R* in




*Calculations determine size of sheet quickly for entering on bill of material*

the figure to the left in the accompanying illustration, because this slant height is equal to the radius used in scribing the arc for the base of the right cone in the development.

Referring to the frustrum of the cone, and assuming *F*, *B* and *a* to be known,

$$A = Ba/b$$

Therefore with *A* and *B* known it is possible to layout the *A* and *B* legs of the right triangle and scale the distance *R* which would be sufficiently accurate for all practical purposes. The length *r* also can be scaled.

To determine *R* mathematically the following method is used:

$$b/a, \text{ or } B/A = \tan n$$

then, trigonometrically

$$R = B/\sin n, \text{ or algebraically, } R = \sqrt{A^2 + B^2}$$

Also, trigonometrically

$$r = b/\sin n, \text{ or algebraically, } r = \sqrt{a^2 + b^2}$$

In the case where *F*, *B* and *r* are known it is possible to determine *R* directly because

$$R = Br/b$$

Now in the development, with *R* as a radius, the arc for the base of the right cone and similarly the arc for the upper base of the frustrum can be scribed.

With the length of the arc for the base of the right cone always equal to $\pi\ 2B$, the number of degrees embraced or subtended by this arc can be determined by

$$X^\circ = \frac{360^\circ \times \pi \times B \times 2}{\pi \times R \times 2}$$

or

$$X^\circ = 360^\circ \times B/R$$

then

$$C = R \sin 1/2\ X^\circ; \text{ when } X^\circ \text{ is less than } 180^\circ$$

or

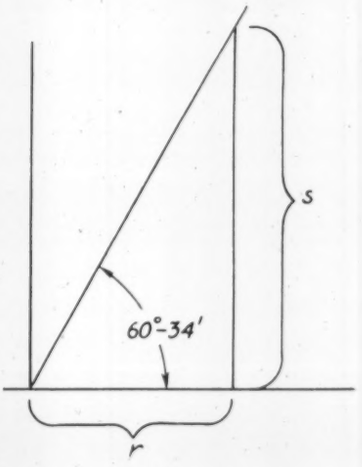
$$C = R \sin 1/2\ (X^\circ - 180^\circ); \text{ when } X^\circ \text{ is greater than } 180^\circ$$

—R. H. LINN,
*Minneapolis*

## Squaring the Circle

*To the Editor:*

MAY I add a suggestion to the calculations for this problem as proposed by W. A. Rosenberger in your May issue on page 35? The introduction of trigonometry into the solu-




*Trigonometry will simplify calculations and permit immediate solution*

tion will simplify the calculations and permit of an immediate graphical solution. Referring to the accompanying illustration

$$s^2 = \pi r^2$$
$$s = 1.77r$$
$$s/r = 1.77 = \tan 60^\circ 34'$$

For any given ordinate *s*, the corresponding abscisca *r* will represent the radius of a circle with an area equal to a square with side *s*, and vice versa.

—W. K. CRESON,
*Lafayette, Ind.*

# TOPICS OF THE MONTH

*A Digest of Recent Happenings of Direct Interest to the Design Profession*

### Reduction in Number of Parts Holds Sway in Design Trends

DESIGN according to the modern interpretation most certainly holds the foreground in the viewpoint of L. F. Loree, president of the Delaware & Hudson railroad. He predicts that both cars and locomotives of the future will be built of far fewer parts. He foresees considerable buying of new equipment for replacements, but it will be of the simpler type.

In building 25 sample cars for the Kansas City Southern last year, Mr. Loree had the floor cast in one solid piece, and the sides and ends welded instead of bolted. This procedure saved 2200 pieces. Referring to locomotives, each of which have about 15,000 pieces, he explains that 831 pieces have been eliminated by casting the cylinders integral with the frame. Putting four tubes in the fire box and drawing them out of the solid metal instead of building them up cut out 660 pieces. There is a lesson for designers of all types of machinery in the ideas of this enterprising railroader.

* * *

### Leipzig Fall Fair Will Exceed All Previous Events in Size

MORE than 100,000 business men from seventy countries will assemble at Leipzig, Germany, for the fall fair to be held from Aug. 27-31. The great international exchange will profit this year from the efforts being made at Geneva and elsewhere to adjust tariffs and stimulate world trade. From centuries of service the Leipzig trade fair has become a clearing house for thirty great producing countries. Despite the depression the event this fall will be over three times the size of any pre-war fair.

* * *

### Tapered Roller Bearing Standard Is Revised and Distributed

ENGINEERS will be interested to know that a revised draft of simplified practice recommendations R67, covering tapered roller bearings and prepared by the standing committee of the industry, has been mailed to all interests in the industry by the division of simplified practice of the bureau of standards, Washington. In addition to bringing the simplified practice recommendation into accord with the Society of Automotive Engineers' revised standard for tapered roller bearings, the proposed revision covers sizes up to 12-inch bore togther with certain steep angle bearings intended for naval and general use.

* * *

### New Corrosion, Heat Resistant Iron Exhibited for First Time

ENGINEERS attending the convention and exposition of the American Foundrymen's association at Chicago viewed publicly for the first time a new corrosion and heat resistant cast iron with the same coefficient of expansion as plain cast iron at elevated temperatures. International Nickel Co. sponsored the exhibit. Composition of the new material is 28-32 per cent nickel, 4-5 per cent chromium and the balance cast iron.

Besides being tough and machinable, it maintains its properties without deterioration at high temperatures, has a hardness of 140-200 brinell and a tensile strength of approximately 30,000 pounds per square inch. It is particularly suitable for constructions requiring a heat or corrosion resistant metal in contact with plain cast iron or steel, where the alloy is used as a liner or insert and attains a higher temperature than its surroundings. Examples are bushings, liners for pumps and compressors handling hot liquids or vapors, and for automobile engine valve seat inserts.

Designers of machines for the foundry industry have developed a number of interesting units to meet the requirements of the new era. At the recent Foundrymen's exposition, the most successful of the restricted shows in the history of the association, were shown several new developments in molding machines; two new and greatly improved core blowing machines; a new device

(*Concluded on Page* 46)

# MEN OF MACHINES

*Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design*

THE name of Fred M. Zeder stands out prominently in automotive engineering history made over the past 20 years. He pioneered many significant advances in the industry, notably high compression engines, floating power, rubber in automotive construction, all-steel bodies and hydraulic brakes. For his encouragement of fundamental research the University of Michigan from which he was graduated in 1909, recently conferred upon him the degree of master of engineering.

As vice president in charge of engineering of the Chrysler Corp., he is in full charge of all research, experimental and engineering activities. Mr. Zeder is a native of Michigan, having been born in Bay City, March 19, 1886. During his school years he also worked as a machinist's apprentice and after graduation was employed by Allis-Chalmers Co. In 1913 he was appointed consulting engineer for Studebaker Corp. of which he later became chief engineer.

In 1920 he began his association with Mr. Chrysler, who then was executive engineer of the Willys interests. When Mr. Chrysler took over the reorganization of the Maxwell Motor Corp., Mr. Zeder was made vice president in charge of engineering, and later when the Chrysler Corp. was formed he assumed the same position.

RECOGNIZING notable achievement in the advancement of aeronautics, the 1933 Guggenheim medal has been awarded to Jerome Clarke Hunsaker. It was he who introduced the application of aerodynamic research in the design of American aircraft by first translating and making available Eiffel's work and later by building the first wind tunnel at Massachusetts Institute of Technology.

Commander Hunsaker, who is vice president of the Goodyear-Zeppelin Corp., Akron, O., was born in Creston, Iowa, in 1886. He was graduated from the United States Naval academy in 1908. The degrees of master of science and doctor of engineering were conferred upon him by M. I. T., where from 1914 to 1916 he was instructor in aeronautical engineering and a research worker in aerodynamics.

While in charge of the aircraft division, bureau of construction and repair of the navy department, he had the responsibility, under chief constructor, for the naval aircraft war program. Commander Hunsaker developed the first modern nonrigid airship produced in the United States, as well as the Shenandoah. In 1927 he resigned as commander, Construction Corps., United States navy.

DEAN of the agricultural engineering profession, Dr. J. Brownlee Davidson is the 1933 recipient of the highest award of the American Society of Agricultural Engineers—the Cyrus Hall McCormick medal. The honor is well deserved. A review of his many and varied contributions to this phase of engineering bears abundant evidence of his qualifications.

Nebraska is Dr. Davidson's native state. In 1904 he was graduated from the University of Nebraska with the degree of bachelor of science in mechanical engineering. Later degrees from his alma mater are the professional degree in agricultural engineering in 1914 and the degree of doctor of engineering in 1931.

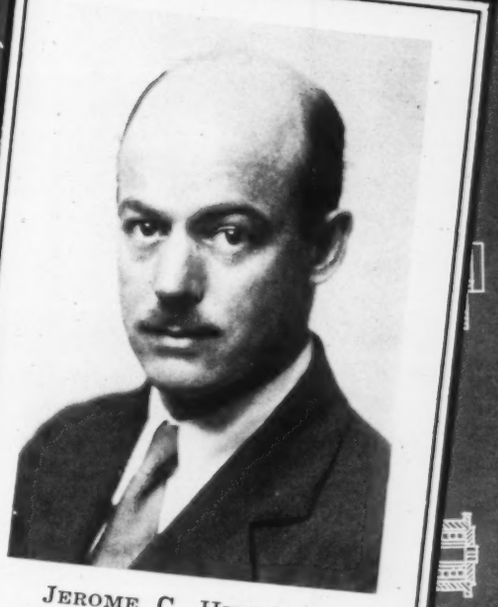
His career has been devoted largely to serving two educational institutions, Iowa State college and the University of California. At present Dr. Davidson is professor and head of the department of agricultural engineering at Iowa State college. He not only is a charter member of the American Society of Agricultural engineers but also was its first president.

ONE industry with which the design profession is associated closely is that of the foundry. Activities of the American Foundrymen' association are of interest, particularly in connection with the recent election of Frank J. Lanahan as president.

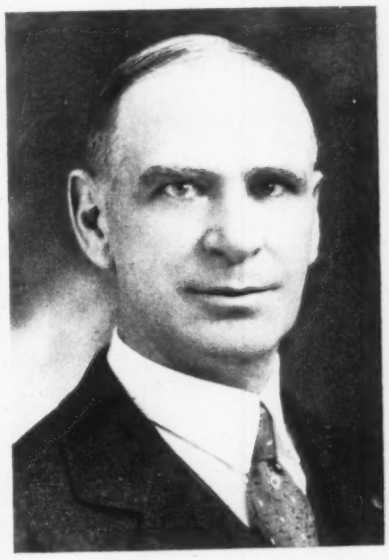
As officer or member of fifty or more business establishments, business associations, committees and clubs, Mr. Lanahan is one of the busiest men in Pittsburgh. Among his business enterprises he is president of Fort Pitt Malleable Iron Co., Pittsburgh; Davis Brake Beam Co., Johnstown, Pa.; Fort Pitt Mine Equipment Co., Jeanette, Pa.; chairman of the board of Auto Tite Joints Co., Pittsburgh, and member of the

# Leaders in Design, Engineering and Research

FRED M. ZEDER



JEROME C. HUNSAKER



J. BROWNLEE DAVIDSON

FRANK J. LANAHAN

board of directors of Warren Foundry & Pipe Corp., Wharton, N. J.

Technical societies with which he is affiliated include the American Iron & Steel institute, Engineering Society of Western Pennsylvania, American Society of Safety Engineers, and American Society of Municipal Engineers. Mr. Lanahan's dynamic personality came into action during the World war when he was a leading spirit in many local and national organizations for war work. Born in Pittsburgh where he has lived continually, he attended Grant public school, Pittsburgh high school, and St. Mary's Academy, Blairsvile.

* * *

H. A. Schwartz, manager of research, National Malleable & Steel Castings Co., Cleveland, received the honorary degree of doctor of science from Rose Polytechnic institute, Terre Haute, Ind., June 10.

* * *

Willis L. King, vice president of Jones & Laughlin Steel Corp., recently was awarded the Gary Memorial medal established by the American Iron & Steel institute to honor Elbert H. Gary, its founder and first president.

* * *

L. E. Jermy, editor of MACHINE DESIGN, recently was elected chairman of the Cleveland section of the American Society of Mechanical Engineers.

* * *

Dr. R. S. Hutton of the Cambridge university, Cambridge, England, will deliver the Faraday centennial address at the meeting of the Electrochemical society in Chicago, Sept. 7-9.

* * *

A. E. R. Peterka has been appointed development and sales engineer of the Lamson Sessions Co., Cleveland. Formerly he was development and research engineer for Western Electric Co., Chicago.

* * *

F. A. Merrick, president, Westinghouse Electric & Mfg. Co., East Pittsburgh, has been elected a director of the National Association of Manufacturers.

* * *

J. M. Crawford, chief engineer, Chevrolet Motor Co.; E. A. Johnston, director of engineering, International Harvester Co. of America; L. V. Newton, automotive engineer, Byllesby Engineering & Management Corp.; and D. G. Roos, chief engineer of Studebaker Corp. of America, have been named as members of the sponsorship committee for the forthcoming S. A. E. International Automotive Engineering congress. Fred M. Zeder, whose picture and biographical sketch appear on the preceding pages, is chairman of the body.

* * *

Harry B. Gear, assistant to the vice president, Commonwealth Edison Co., Chicago, recently was elected president of the Western Society of Engineers.

* * *

G. H. Clamer, president of Ajax Metal Co., Philadelphia, has received the honorary degree of doctor of science for his prominence in metallurgy, from Ursinus college, Collegeville, Pa. He also is the recipient of the Joseph S. Seaman gold medal of the American Foundrymen's association for his outstanding achievement in the metal casting industry.

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## Obituaries

FRANCIS H. RICHARDS, consulting engineer and inventor, died recently in New Britain, Conn., at the age of 83 years. In recent years he had been consulting engineer and designer with the Pratt & Whitney Co. and had hundreds of patents to his credit, among them automatic weighing machines, machine tools and appliances, etc. He was one of the founders of the American Society of Mechanical Engineers, which awarded him a medal in 1930 in honor of his having been a member for a half century.

* * *

William Harper Gray, chief engineer of the Iron Fireman Mfg. Co., died recently. He was outstanding in the development of the mechanical stoker and for the past nine years had been associated with the Iron Fireman company. Born in England Capt. Gray was educated for the British navy and served for a number of years in the British merchant marine. After coming to the United States he engaged in engineering, and at one time was consulting engineer for the Heintze interest in Montana. His headquarters for the past years had been at the Cleveland manufacturing plant of his company.

* * *

Herman Dock, widely known design engineer, died recently in Guadalajara, Mexico. At one time he built engines for marine and government work. Six of these engines have a novel upper end on the connecting rod which eliminates the use of a piston pin. Mr. Dock was best known perhaps by the Rivett-Dock threading tool for engine lathe work, but his inventive efforts ran largely to variable speed transmissions and internal combustion engines.

# NOTEWORTHY PATENTS

*A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design*

DESIGNED for balance and prevention against becoming vapor bound, a multistage centrifugal pump having an odd number of impellers has been patented by Aladar Hollander for Byron Jackson Co., Berkeley, Calif. The first impeller is the double suction type, Fig. 1, while the others are single suction units. Though all five impellers are the same diameter the double suction unit has a greater capacity than any one of the others.

As discussed by the inventor, where high velocities are employed on the suction side of centrifugal pumps or where the pump is placed at a considerable height above the surface of the liquid being pumped, effecting a high degree of vacuum on the suction side, the pump frequently becomes vapor bound, destroying the continuity of the fluid column. Mr. Hollander claims this condition has been obviated by employing large areas and therefore low velocity throughout the first stage of pumping.

The first stage impeller 10 draws liquid from the suction inlet 8 and discharges it into volute passage 11. From this passage it is delivered to the suction side of impeller 12 which provides the second pressure stage, forcing liquid through volute 13 to the suction side on the right of impeller 14. This in turn delivers liquid into volute 15, after which it is taken by impeller 16 and raised to the fourth pressure stage. Through volute 17 it enters from the left to the suction side of impeller 18 which delivers liquid pumped to the fifth pressure stage through volute passage 9, the discharge outlet.

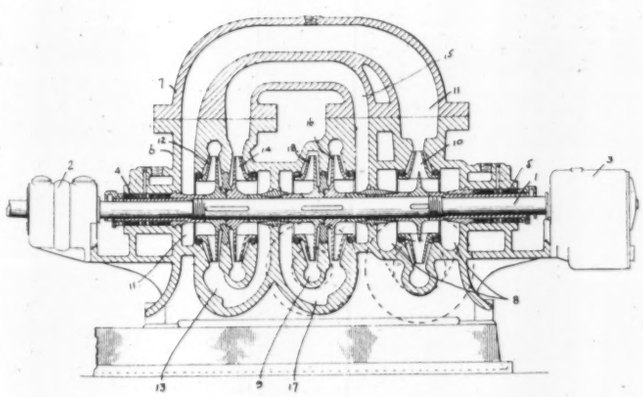


*Fig. 1—Multistage centrifugal pump designed for hydraulic balance of the impellers*

Conventional closures between the several stages are provided and it will be noted that glands 4 and 5 are exposed only to the first stage of pressure and suction of impeller 10. Leakages between impellers are confined to differences of one stage of pressure and therefore are a minimum. Impeller 10 being of double suction type provides a much greater area, in this case twice the area of inlet, than the other impellers. Consequently the velocity of flow of fluid into the first impeller is substantially one-half the velocity of flow into suction side of the other impellers.

Impeller 10 is in hydraulic balance, receiving equal pressures and velocity on equal and opposite areas and delivering the same in a peripheral direction. Impeller 12 and 14 also are balanced, their areas being equal and opposite as regards direction of pressure. The same is true of impellers 16 and 18. The pump therefore presents an hydraulic balanced rotating element with minimum pressures at the glands 4 and 5, and with no greater than one stage of pumping pressure difference between any two compartments or adjacent impellers. The patent is designated No. 1,912,452.

TO PREVENT transfer of undesirable vibrations between driving and driven members of a machine, Frank H. Hibbard has designed a vibration absorbing mounting employing U-shaped springs, Fig. 2. In certain applications, as for example sound reproducing machines, it is necessary not only to eliminate vibrations of relatively high frequencies but also those of lower frequency such as the 60-cycle vibration set up by the power supply of a motor. This requires a mounting having a resonant frequency which is preferably of the order of 5 to 10 cycles. To obtain this with simple helical spring arrangements of well known types the springs would have to be of large diameter and of considerable length, which would result in a bulky and unstable structure.

This difficulty is overcome in the invention by mounting the motor on flat, preferably U-shaped springs 13 secured in position by the motor mounting bolts which are provided with short helical springs 17 for adjusting the motor to the

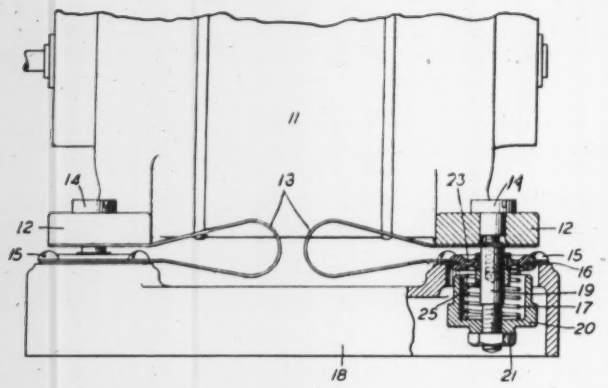



*Fig. 2—Vibration-absorbing mounting employs flat U-shaped and helical springs*

correct operating level and compensating for slight variations in the flat springs.

The mounting member 16 comprises a rubber disk 23 of low stiffness secured at its periphery to the base plate. Disk 23 is provided with a central metal bushing 25 which has no metallic connection with the plate. Stud 19 passes through the bushing with a sliding fit. Springs 17 are held in compression by nut 21 and cause stud 19 which is secured to mounting lug 12, to slide through bushing 25 to bring the motor to proper working position. Electrical Research Products Inc., New York, is assignee of the patent which is No. 1,912,451.

USE of a slip clutch and universal joints in providing a flexible drive shaft is the basis for a patent recently taken out by Rex B. Hitchcock for International Harvester Co., Chicago. Universal knuckles 5 and 12 and the other elements of this device, Fig. 3, are so constructed that the axes on which the knuckles pivot on their respective center blocks are parallel. When two double-Y universal joints are utilized on an intermediate shaft between a driver and driven shaft the axes of the universal knuckles carried by the intermediate shaft must be parallel to correct for variation in angular velocity and to transmit to the driven shaft the same uniform velocity as the driving shaft.

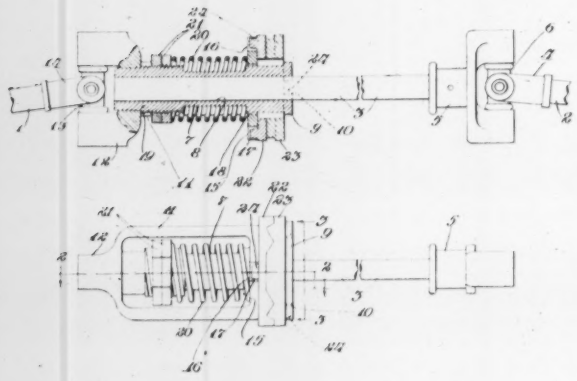


*Fig. 3—Two universal joints and an overload slip clutch provide flexible shaft*

The slip clutch is constructed to co-operate with the universal knuckles carried by the intermediate shaft to maintain the axes parallel during transmission of motion. Clutch member 22 is carried by the yoke 11 which is integral with and rotates with knuckle 12. Clutch member 23 is carried by sleeve 7 which rotates with shaft 3 and knuckle 5. Spring 20 resiliently presses the engaging faces of clutch members 22 and 23 together. With the application of a torque to the driving shaft greater than that amount at which the clutch is set to slip, clutch members 22 and 23 disengage and ride over each other.

Due to the design of the clutch member faces they will not mate in engaging position until the two members have been rotated a half revolution or 180 degrees. By this construction the two faces will ratchet over each other until the torque applied to the drive shaft decreases to an amount less than that at which the clutch slips. Nuts 21 may be adjusted to vary the compression on spring 20, thereby regulating the amount of torque which may be transmitted through the clutch before slippage. No. 1,911,507 identifies the patent.

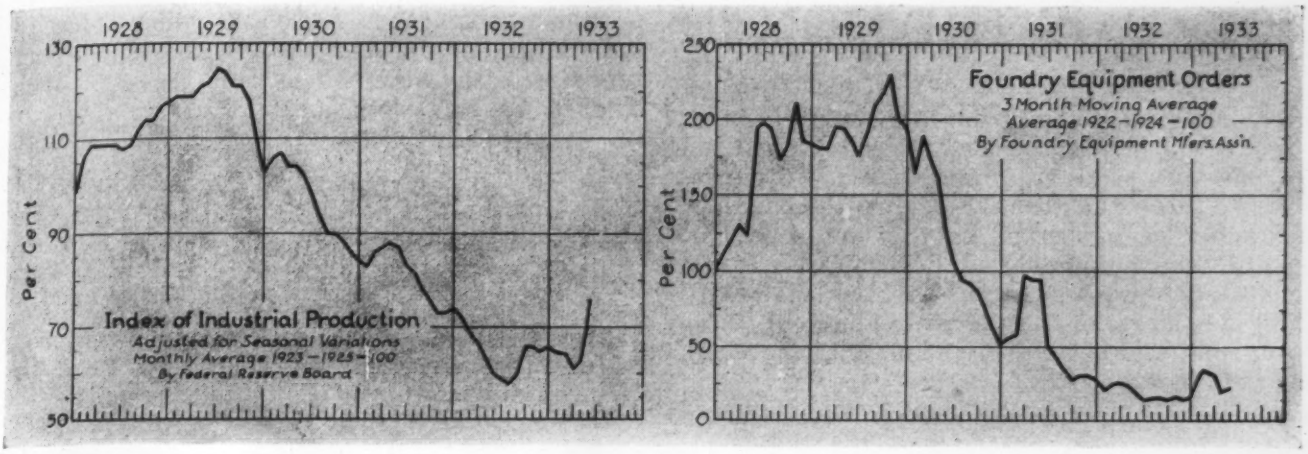
## Review of Noteworthy Patents

Other patents pertaining to design are described briefly as follows:

SEWING MACHINE—1,908,280. Covered by this patent is a sewing machine of the type having laterally vibrating stitch-forming mechanism. One object is to provide more room under the gooseneck of the machine; another is the provision of an improved coupling between the loop-taker actuating shaft and the loop-taker. Assigned to Singer Mfg. Co., Elizabeth, N. J.

COLLAPSIBLE REEL—1,905,178. One of the objects of this invention is to provide a collapsible reel having a working surface which is cylindrical and continuous when the unit is expanded to its operating position. It is designed to be operated by rotation of a portion of the reel relative to the shaft on which it is mounted. Assigned to United Engineering & Foundry Co., Pittsburgh.

EPICYCLIC GEARING—1,910,777. This invention relates to the type of epicyclic gearing in which a large speed-ratio is obtained between co-axial driving and driven members by the use of a pair of co-acting gear wheels of nearly equal size. A further object is to provide a form of such mechanism which shall be reversible as regards the direction of rotation of the driven member relative to the driving member without declutching either member. Assigned to Frederick Soddy, Oxford, England.

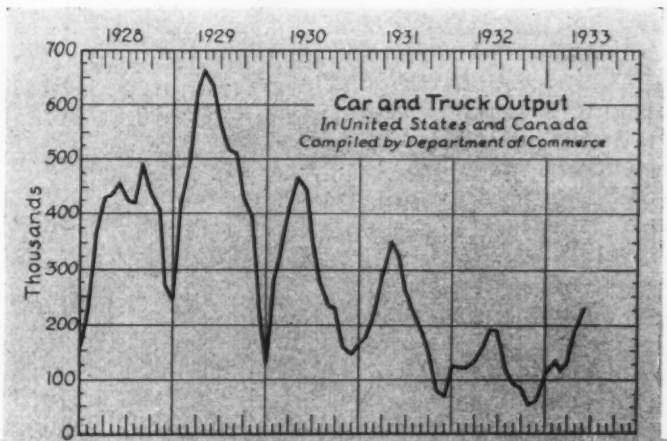


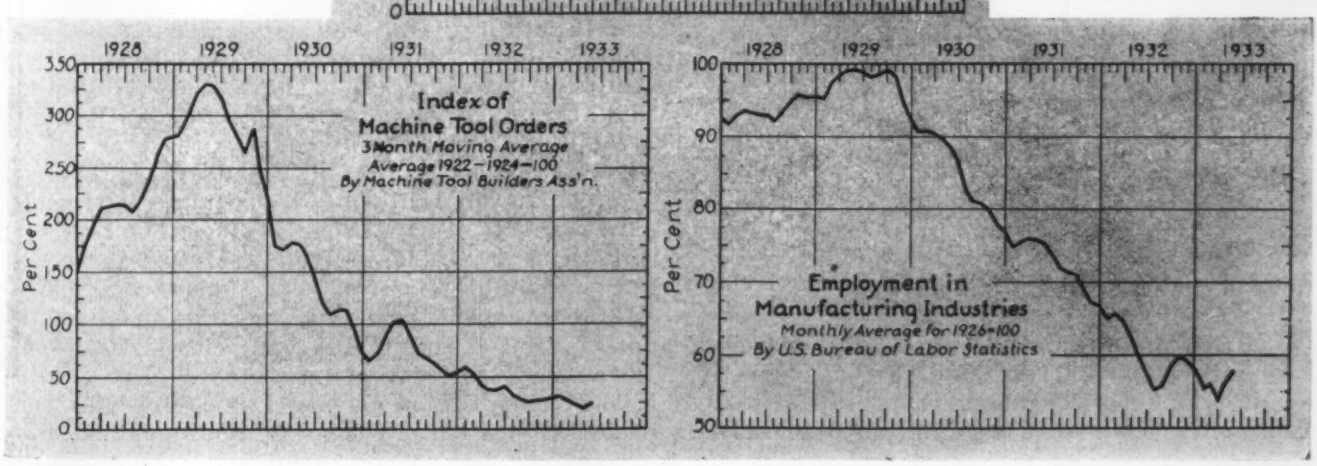

# How Is Business?

WHEAT has passed the dollar mark. Cotton has hit ten cents. All farm produce had advanced, and even though the manufacturer may have never seen a hoe, such news is of tremendous interest to him. The opening of even a fraction of the enormous farm market is essential to permanent recovery.

The spectacular rise in commodity markets within the past few weeks even though of great benefit to the farmer may have a retarding effect on general business unless this increase is reflected in increased buying power of the man in the shop, the ultimate destination of the produce. However, the increased activity in all lines of manufacturing, the many pay increases which have been accorded labor, and the activities of Nira should aid in preserving proper balance.

One month ago, three major industries were still outside the convalescent ward. These were building construction, farming and railroads. Farming has joined the select group, and the improvement in this field was more than equalled by the huge upturn in building construction during May, an increase of 128.6 per cent above April. Now only the railroads remain in the lower bracket and a tonic of generally increased business will most certainly aid this unfortunate. Freight car loadings already reflect the increase.



# TOPICS OF THE MONTH

(*Concluded from Page* 39)

for cleaning castings by employing centrifugal force to throw the abrasive against the castings; a number of important improvements in sand conditioning equipment; a new apparatus for separating and cleaning abrasive materials; three new types of dust arresting and collecting equipment and noteworthy displays of materials handling equipment.

Attendance at the show which was staged at Stevens hotel, was gratifying. Outstanding features of several machines included the use of oilless bearings on various moving parts. Increased utilization of compressed air also was observed, in addition to a continued upward trend in the direction of automaticity, improved appearance and compactness.

* * *

### Pyrometer Lamp to Measure Furnace Temperature Creates Interest

THOUGH only indirectly related to the design profession, a new pyrometer lamp which measures the temperature of a furnace within 5 to 10 degrees Cent., is nevertheless a topic of interest. The unit consists of a black coated pear-shaped bulb containing an inverted U-shaped carbon filament and a small eyelet about $\frac{1}{8}$-inch apart. These are mounted midway between two windows in the bulb and in such a manner that the eyelet and the horizontal portion of the filament are on a line of sight between the centers of the windows.

When measuring furnace temperature, the lamp is held near the furnace door and the part to be measured is viewed through the windows of the bulb. Brightness of the filament is adjusted by varying the current through it by means of a rheotsat until it reaches that of the furnace, at which time the filament current is read on an ammeter. The temperature corresponding to this current value then is read from a calibration chart.

* * *

### New Finish Imparts Decorative Effect To Zinc Die Cast Parts

AMONG the newer and more widely discussed finishes now being applied for decorative effect on zinc die castings is the so-called patina treatment, which is an antiquating process produced by electrodeposition of metallic oxides. Greens, blues, browns and golds which simulate the patinas of naturally corroding copper and bronze may be obtained by this process. It is said to be relatively inexpensive.

* * *

### Presents Paper on "Overnight" Test To Check Endurance Limit

CONSIDERABLE interest has been aroused by the paper on "An 'Overnight' Test for Determining Endurance Limit," presented by H. F. Moore and H. F. Wishart, before the American Society for Testing Materials recently. The authors claim that eminently satisfactory results can be obtained by this abbreviated method. Chief obstacle to the development of fatigue testing of metals on a commercial basis has been the long time required to make an accurate determination of the endurance or fatigue limit.

The method discussed has been checked against long-time fatigue tests for structural steel, cold rolled steel, brass, monel metal, nickel steel, chromium nickel steel, duralumin and specimens of cold rolled steel with sharp notches. Maximum variation observed in endurance limit as determined by the "overnight" test and as determined by the long time test was 11.8 per cent, for duralumin. It is obvious, they declare, that the "overnight" test may be shortened materially or the number of testing machines required may be reduced by the use of higher speed machines than those running at 1500 revolutions per minute.

* * *

### City Gas Employed As Fuel in Auto Truck by English Engineers

OPERATION of automobile trucks using city gas as fuel has been practiced for some time in England by merely removing the gasoline tank and tubing and substituting for them gas cylinders and reducing valves. To keep the weight of the cylinders within reasonable limits and at the same time to provide sufficiently high strength to resist the high pressure, it was necessary to select the cylinder material carefully.

Steel of the following approximate composition was chosen: Carbon, 0.30; nickel, 3.00; chromium, 0.90; and molybdenum, 0.40 per cent. All experimental steels were subjected to hydraulic pressure, bursting, crushing and flattening, as well as to the standard tensile and hardness tests. The gas cylinders each have a free gas capacity of about 350 cubic feet and the working pressure is about 3000 pounds per square inch.

# ASSETS TO A BOOKCASE

*Review of Books Pertaining to Design*

### The Technical Man Sells His Services

*by Edward Hurst; published by McGraw-Hill Book Co. Inc., New York; available through* MACHINE DESIGN *for* $2.00 *plus* 15 *cents postage.*

Not a few engineers in the past two years have gone through the experience of hunting a new job. Some were fortunate at the start but others are just now finding a place. To those who still are on the "prospect list" this new book will not come amiss. It might even aid those who have become employed by suggesting the proper approach to promotion.

Though the outline was developed originally as a private edition supplied to seniors of Massachusetts Institute of Technology, its appearance in published form is timely in view of the fact that the new man out of college is not the only class of engineer who may be looking for work. It is safe to say that the seasoned engineer who has been employed steadily for 10 or 15 years but who was caught by the depression has a keen appreciation of this type of data.

Surveying the various chapters, the reader will find discussion on such topics as analization of the job finding problem, selling science to industry, contacting employer prospects, commonsense plus science plus salesmanship, interview preparations, etc. Pertinent to readers of this journal is chapter six, entitled "The Case of a Young Man Who Had Studied Machine Design under Professor X." It presents an interesting angle on the theoretical versus the practical aspect of technical training.

□ □ □

### Heating and Ventilating Engineers Guide

*published by the American Society of Heating and Ventilating Engineers, New York; available through* MACHINE DESIGN *for* $5.00 *plus* 15 *cents postage.*

In view of the broadening interest in air conditioning, a new field in which designers will play a prominent part, the data contained in this guide serves a distinct and timely purpose. This eleventh annual edition has been extensively enlarged and revised to include the latest results of research and modern engineering practice.

Designers of heating, ventilating and related equipment will want to study particularly the chapters covering mechanical stokers, oil burners, thermodynamics of air conditioning, cooling and dehumidifying, control of air conditioning systems, design of air ducts, etc. Those engineers who have not long been engaged in this field will be able to obtain a thorough background through this book.

The 1933 guide depicts with startling clarity the scope of developments that have occurred in the field of heating, ventilating and air conditioning within a short period of time. New standards of American Society of Heating and Ventilating Engineers, adopted in 1932, are included together with other important data. Much of the information came from co-operative studies at the School of Public Health, Harvard university. Considerable information heretofore unpublished will be found in chapters 24 and 25 on central fan heating, central fan cooling and air conditioning systems.

□ □ □

### Standard Handbook for Electrical Engineers

*Frank F. Fowle editor-in-chief; published by McGraw-Hill Book Co. Inc., New York; available through* MACHINE DESIGN *for* $7.00 *plus* 15 *cents postage.*

So closely are electrical and mechanical phases interwoven in present-day design of machinery that it has become necessary for the engineer to be able to understand both thoroughly. Because the machine designer generally is more familiar with mechanical details than electrical such a volume as this electrical handbook will serve a distinctly practical purpose. In this sixth edition more than 600 pages of new data have been added.

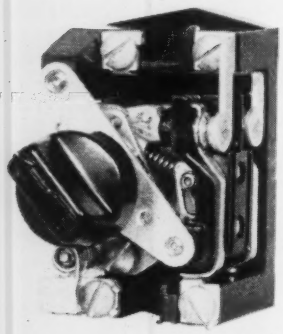
Of particular interest is the new material on electrical household appliances, applications of vacuum tubes, electrical heating applications, motor circuits, development of large size diesel engines, modern alloys for electrical conductors, co-ordination of electrical systems, etc. In addition the numerous other departments which have been revised and brought up-to-date contain much information of direct value to design engineers.

# NEW MATERIALS AND PARTS

*Worthy of Note by Those Engaged in the Design of Mechanisms or Machines*

## Switches Have Overload Protection

SMALL, hand-operated starting switches for providing full protection against stalled-rotor current and injurious overload conditions are being produced by General Electric Co., Schenectady, N. Y., for use with either single phase alternating current or direct current fractional horsepower motors. The alternating current switch is available in single and double pole forms.



*Starting switches include a positive snap action mechanism which is trip free on overload*

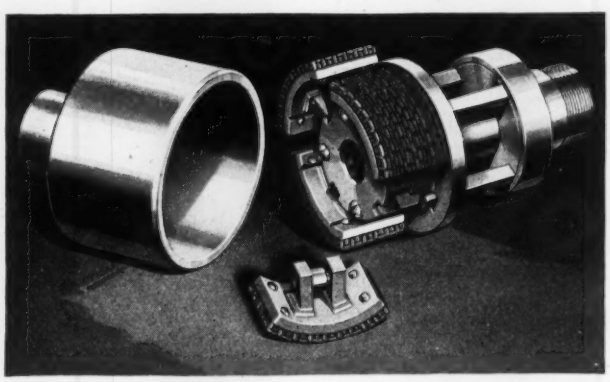
The new switch, shown herewith, affords the following features: Overload protection, a positive snap action mechanism which is trip free on overload; sturdy and compact construction; and adaptability for mounting in purchasers' enclosures. The switch has been tested and listed by the Underwriters' Laboratories.

## Composition Material Resists Shock

POSSESSING several times the shock resistance of ordinary molding material, the new "Impact" composition material developed by Bakelite Corp., New York, is said to have superior mechanical properties. In many respects the new product is similar to laminated products, but it differs in that it can be molded and, therefore, is adaptable to a wide range of shapes. It consists of fibrous materials processed with Bakelite resinoid, and is suitable for efficient production methods as parts made from it often can be produced more cheaply than by machining. Parts made from this material have an attractive surface finish.

## Coupling Performs Four Duties

COUPLINGS which perform four important duties, which are starting, coupling, cushioning, and limiting the load, have been added to the line of equipment being marketed by Falk Corp., Milwaukee. The primary function of the Falk-Rawson coupling is as an automatic starter centrifugally operated. The construction involves two drum-shaped members, one attached to the driving shaft and the other to the driven shaft. Between driving and driven members are inserted two sets of floating segments, made usually of brake lining reinforced with lead, the amount of lead being calculated to give the required centrifugal pressure for carrying the load. The outer segments are actuated by the driving member and the inner by the driven member. A photograph and complete description of the cou-



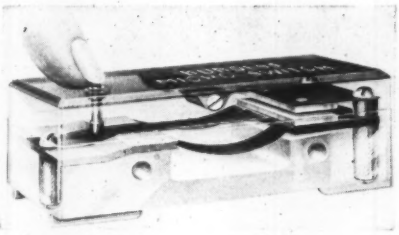
*Brake lining reinforced with lead is used on coupling shown here employed as a brake*

pling is given on page 72 of the May, 1931, MACHINE DESIGN.

In brake applications, shown herewith, the driven drum is fastened down and the driving drum connected to the moving parts the speed of which is to be checked. Beyond a certain speed, the shoes overcome the spring resistance and take hold of the driven drum, acting as a brake. Here the inner shoes are superfluous, and springs are used in the outer shoes to prevent dragging until the excessive speed is reached.

## Micro Switch Is Compact

REQUIRING approximately one thousandth of an inch movement and a few ounces pressure, the new compact micro switch being marketed by C. F. Burgess Laboratories Inc., New York, is capable of handling sufficient current for the majority of electrical control functions. In this quick acting switch, shown herewith, a plunger protrudes through the top and receives the energy required to operate the



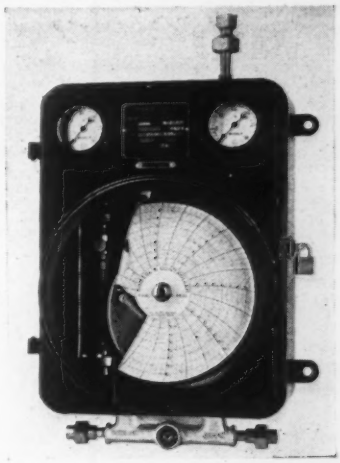
*Beryllium copper is employed as contact springs on new compact switch*

mechanism. The use of beryllium copper for contact springs provides freedom from fatigue or crystallization; a permanence of original operating characteristics and no deformation; and ability to withstand high temperature. The switch is rated at 10 amperes, 110 volts, 5 amperes, 220 volts, alternating current.

## Announces Improved Controller

NEW time temperature and time pressure controllers have been introduced by Bristol Co., Waterbury, Conn. In many process machines it is desired to regulate a temperature, or pressure, at some fixed rate, and then either hold it or decrease it at some other rate. These new controllers will do this on any range of temperatures from minus 40 to 1000 degrees Fahr., or pressure from 10 to 2000 pounds.

The model 8040 MT controller, shown herewith, is of the large cam type. The cam here consists of a graduated chart on sheet aluminum that may be cut by the user to give any desired control characteristics. The cam is driven either by an electric clock or by a high grade spring. Air supply and control gages are mounted self-contained, and

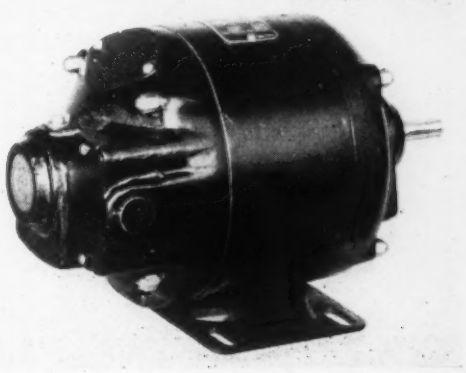


*Controllers are designed to regulate time temperature or time pressure within close limits*

the whole is enclosed in a compact moisture proof aluminum case. Another model manufactured by the company is equipped with an indicating pointer which shows the instantaneous pressure or temperature at all times.

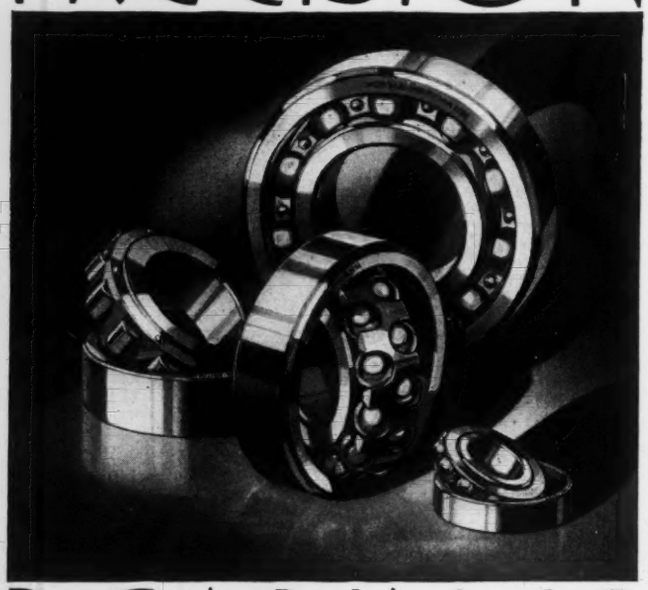
## Motors Are Drip Proof

FRACTIONAL horsepower motors especially designed for driving small water pumps have been developed by General Electric Co., Schenectady, N. Y. Among the features of the new motor, which has been designated as Type RSA, are drip-proof end flanges to prevent dripping water from entering the motor, a large bearing-



*Drip-proof end flanges protect motors against dripping liquids*

PRECISION



BEARINGS

PRECISION—as the term defining the characteristics distinctive of NORMA-HOFFMANN Bearings—comprehends ALL those qualities which reveal themselves in higher anti-friction efficiency, greater speed-ability, better performance, longer life, fewer replacements, improved production. ✲ ✲ ✲ These are the definite and tangible gains which accrue to the builder and user of any machine in which NORMA-HOFFMANN PRECISION Bearings are incorporated. ✲ ✲ ✲ Write for the PRECISION Bearing Catalogs. ✲ ✲ ✲ Let our engineers work with you—without obligation.

"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORP., STAMFORD, CONN., U. S. A.

oil capacity, and a built-in terminal box for simplifying installation by eliminating all necessity for splicing and soldering connections. The performanace characteristics of the motor are in accordance with NEMA standards for short annual service. The motor is available in 1/6, ¼ and 1/3 horsepower ratings, with interchangeable mounting dimensions. In addition to water pump service, this motor is adaptable to such applications as beer pumps, oil and grease pumps, certain types of circulating pumps, small machine tools and other devices requiring similar load characteristics.

## Introduces New Drum Controllers

DRUM controllers for reversing fractional horsepower motors in a new line have been introduced by Furnas Electric Co., 1525 South Seventy-seventh street, West Allis, Wis. Frames of the new controllers are formed from heavy gage steel in one piece. The spindle is of square cold rolled steel, accurately turned for a bearing at each end. Spindle insulation is square bakelite tubing. Indexing in the off position is by spring and notch plate, the same procedure followed in earlier designs by the company.

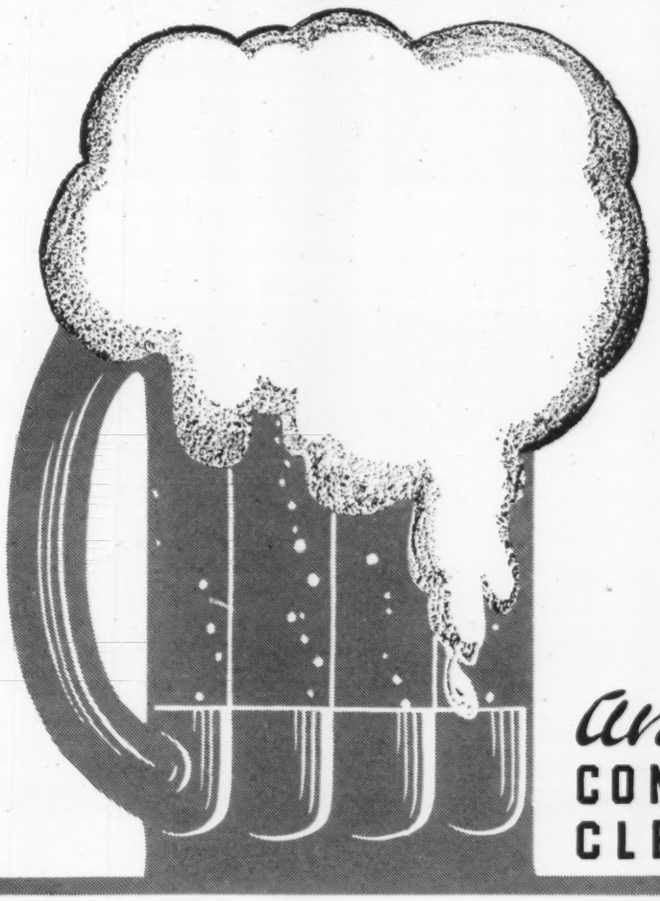
*Small drum controllers may be used for practically any application where it is desired to reverse small motors*

These small drums, shown herewith, are designed for use with small bench lathes, but may be used for practically any other application where it is desired to reverse small motors. They also may be used for plain starting and stopping where accurate control is an important consideration.

## New Molding Compound Developed

AVAILABLE in a variety of colors and types producing mottled and opalescent effects, the Plioform molding compound developed by Goodyear Tire & Rubber Co., E. Market Plant,

# *With a* STEIN ON THE TABLE



## *and* YOUR CONSCIENCE CLEAR • • •

When you have put into a design all that you have in modern, efficient designing—when you have protected the equipment at every point with our Alemite High Pressure Lubrication System—and when you have DEFINITELY SPECIFIED the type or types of Alemite Lubricants to be used therewith—THEN everything will be as rosy as this song.

But, remember, the 3-way equation as outlined above is the only way your conscience can be entirely clear!

Why? Listen!

Unless you have put the most modern designing into the equipment, it isn't built to meet modern production standards.

Unless you have protected it with an Alemite High Pressure Lubrication System, you haven't guarded it against the negligence bound to be met in the hands of users' employees.

Unless you DEFINITELY SPECIFY that Alemite Lubricants be used to lubricate the equipment, you are not protecting the lubrication system with the thoroughness it deserves.

May Alemite—without cost—without obligation—prove to you that these claims are just?

ALEMITE CORPORATION (Division of Stewart-Warner)
1890 N. Crawford Avenue, Chicago, Illinois 763

Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name.....

Company.....

Address.....

City..... State.....

PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

● **Superlatives fail to describe properly the perfection of classic Greek sculpture and art. Its beauty is unsurpassed . . . its quality unchallenged « « In the fields of engineering, architecture, and art DIETZGEN Drawing Instruments occupy a similar position. They are of the finest quality possible to produce . . . in *every price range* . . . and are accepted as "standard" among professionals and schools. Quality is unexcelled, parts are standardized and interchangeable . . . so for value and lasting satisfaction use DIETZGEN Drawing Instruments.**

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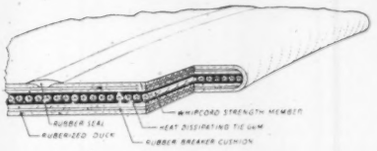
**DIETZGEN**

*Eugene Dietzgen Co., Manufacturers of Drafting and Surveying Supplies*
Chicago New York New Orleans Pittsburgh
San Francisco Milwaukee Los Angeles Philadelphia Washington
*Factory at Chicago*

Akron, O., is unbreakable in a similar sense to other high grade plastics. The material is made of pure pale crepe rubber but contains no sulphur and does not require vulcanization. In addition to its use in ware of various kinds, it is particularly suitable for the manufacture of molded electrical parts.

## Belt Is of Whipcord Construction

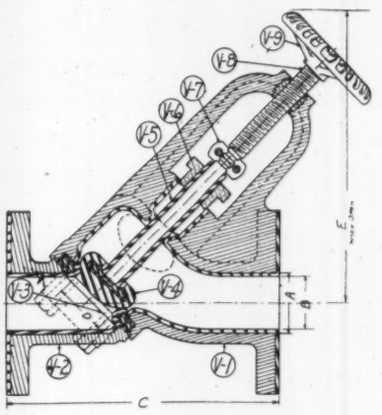
AN ENDLESS-WOUND whipcord construction that has no inelastic stretch is featured in the new belt being offered by Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J. This belt is to be known as the Condor Whipcord transmission belt. Its single cord section is the equivalent of six duck plies in strength and is more flexible.




*Whipcord construction provides belt with no inelastic stretch*

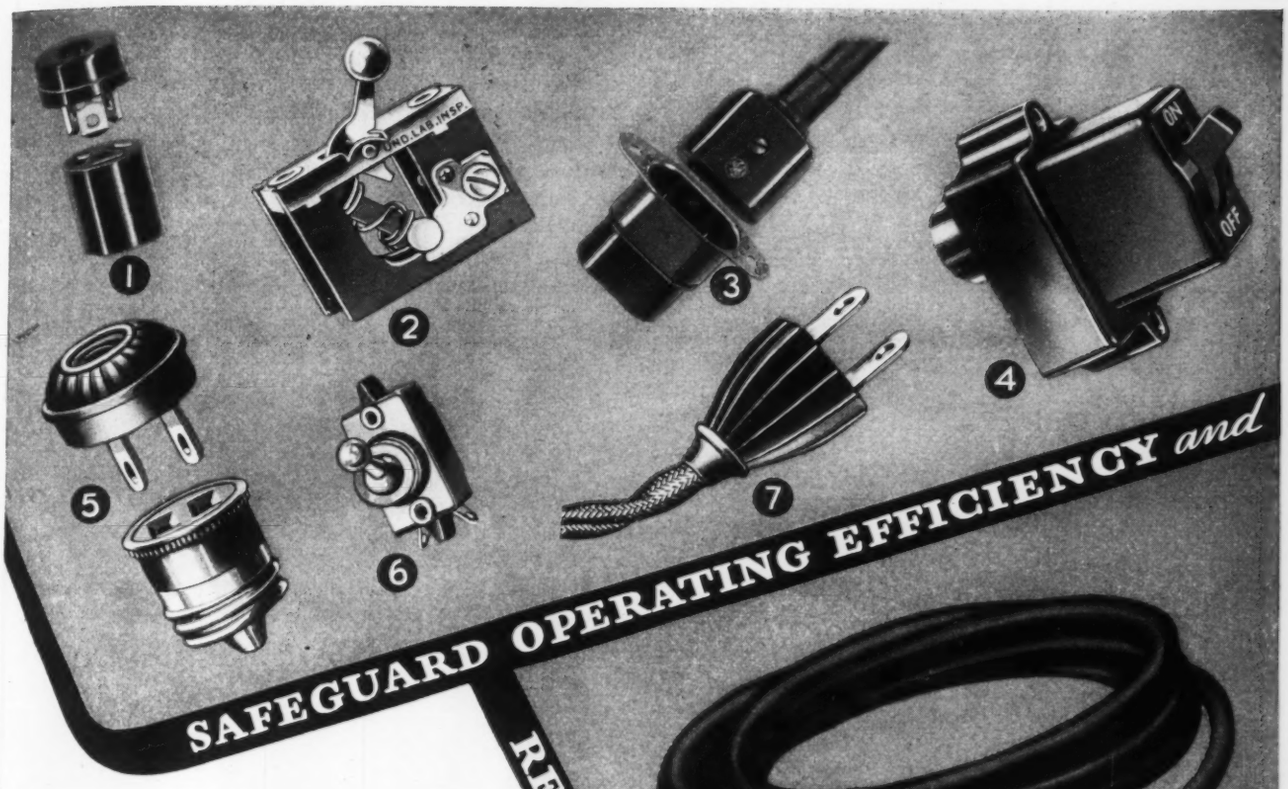
## Valve Is Rubber Lined

DESIGNED for handling corrosive and abrasive fluids under conditions of fairly high pressure, pulsating pressure, throttling or suction, a new rubber-lined valve of simple, rugged design, known as the Vulcalock valve has been announced by B. F. Goodrich Co., Akron, O. The new valve, shown herewith, may be lined with any of the standard Acidseal rubber compounds, hard or soft, depending upon conditions of service.




*Bonded rubber lining protects valve against the deteriorating effects of corrosive or abrasive substances*

Action of the valve does not depend upon a




## USE G-E ACCESSORIES

The operating efficiency of appliances depends largely on the small electrical accessories used. The failure of any one of these accessories makes the appliance useless. Therefore, be sure the accessories you use are the best available. You will avoid costly servicing and replacements.

The complete line of G-E Accessories is accurately designed and carefully manufactured. Their dependable performance and uniformity of quality will insure uninterrupted "trouble-free" service for your products.

1. Three-pole connector body and cap.
2. Skeleton tumbler switch.
3. Miniature connector and receptacle.
4. Motor control switch.
5. Textolite attachment plug.
6. Tumbler switch.
7. Midget rubber plug.
8. All-rubber unicord.

General Electric offers the services of trained specialists to assist you in working out your problems. For further information, write Section Q-3, Accessory Equipment Sales, Merchandise Department, General Electric Co., Bridgeport, Connecticut.

SAFE Electrical Cords
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UNDERWRITERS LABORATORIES INSP. CORD

# GENERAL ELECTRIC

## ACCESSORY EQUIPMENT

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

ALLEN

TRI-MARKT TRADE MARK

HOLLOW SCREWS

of

Chrome-

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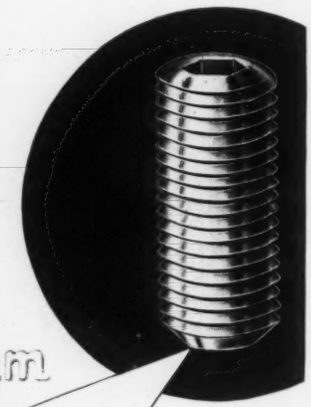
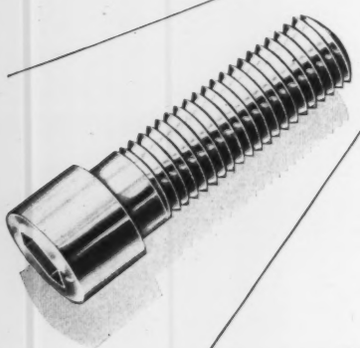




Ask

now for

samples of

holding power

in Hollow Screws

—*specify your sizes*

MACHINE DESIGNS, improved or perfected to include betterment of component parts, should include the screws to hold them together. *Holding power* is in strength for tight set-ups; deep, true sockets for wrench-leverage; accurate threading to resist loosening in vibrating parts. . . . Ask for samples of HOLDING POWER in Allen Chrome Molybdenum Screws—Cap or Set. Their strength may simplify your designs, or suggest advantages in assembly-detail. . . . *Specify sizes* for trial. » » »

THE ALLEN MFG. COMPANY

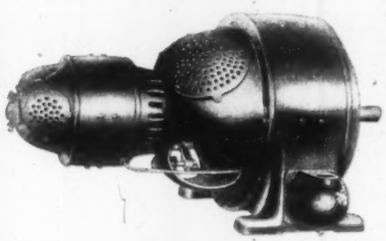
*HARTFORD, CONN. U. S. A.*

flexible diaphragm. The resiliant rounded disk which snaps over a circular plate at the lower end of the stem provides an absolute seal when brought into contact with the molded rubber-covered seat. Both disk and ring are simple, replaceable parts. The lining of the valve is bonded to the metal parts with practically integral adhesion by the Vulcalock process. Corrosion or abrasive materials come in contact only with rubber especially designed to resist their deteriorating action, thus detrimental effect of these substances is obviated.

---

## Introduces New Line of Generators

ALTERNATING current generators in sizes from 0.6 to 75 KVA have been brought out by Marble-Card Electric Co., Gladstone, Mich., in a new line. The generators are of the separately excited type and have the direct current exciter bolted directly to the main generator frame as shown in the accompanying illustration. Two ball bearings are used to support the exciter shaft and two for the main generator shaft, the two shafts being coupled together by a flexible coupling.



*Direct current exciter is bolted directly to main generator frame*

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## Design Prolongs Packing Life

AN INADVERTENT misstatement was made in the article published in the June issue of MACHINE DESIGN entitled "Careful Design Prolongs Packing Life," in discussing the correct stuffing box depth for good design. The paragraph as published read: "Stuffing box depth should be approximately six times the width of the packing space. (Difference between rod and stuffing box diameters)." The sentence between the brackets is incorrect as it now stands. It should read: "(One-half the difference between rod and stuffing box diameters)."

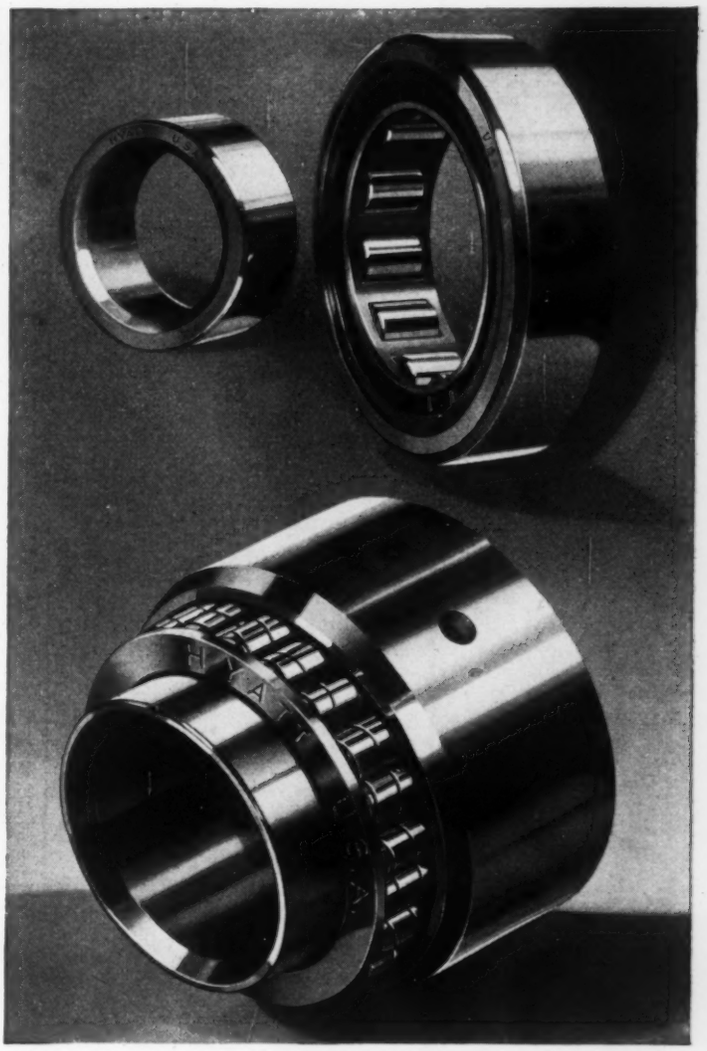
# The . . . SAVING GRACE of CERTAINTY

Making sure of bearing equipment in the beginning is the best promise of uncompromised satisfaction in the end.

Hyatt Roller Bearings have demonstrated their worth. Everywhere they are standing up under the most severe shocks and loads. They are giving day-in-and-out dependable performance, never asking time off except for occasional lubrication.

The exceptional bearing performance which Hyatts deliver is the result of "controlled quality" wherein design, materials, and production are held to unusually high standards. Every step of Hyatt manufacture is subject to rigid supervision. All Hyatts are built to maintain the excellence of the machines or equipment they serve.

Certainly you prefer proved bearings. We assure you that Hyatts offer the greatest security and certainty. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.

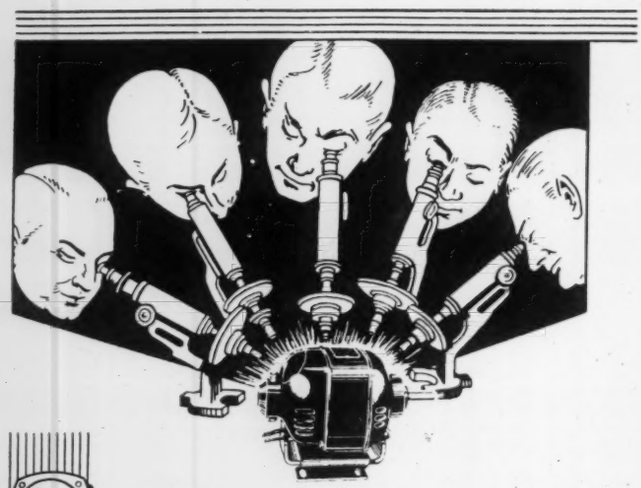


Illustrated above, the Hyatt Single Row Bearing with solid rollers and the Standard Series employing helical rollers. There is a size and type of Hyatt bearing for every need. Our engineering facilities are at your command.

# HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



# By Way of Explanation

THE acceptance of the Leland cradle-base motor for a great variety of appliance applications requiring quietness and freedom from vibration continues to gain. A partial list of its main features is, therefore, in order.

*General Features*

1. Basically sound in general design
2. Particular care in manufacture
3. Compact and attractive in appearance

*Special Features*

4. More effective utilization of active material.
5. Distinctive cradle base design
   a. Makes motor remarkably quiet in operation
   b. Prevents transmission of inherent motor noises
   c. Keeps shaft aligned regardless of thrust conditions.
6. Liberal bearing surfaces coupled with continuously circulating filtered lubrication
7. Exceptionally durable short-circuiting mechanism
8. Simple brush-lifting device that positively prevents brush noise
9. *Available in totally enclosed design for use where exposed to ashes or dirt*

This motor makes an ideal refrigerator, oil burner, stoker or air conditioner drive and is extensively sold for such applications.

Obtain a Leland motor—for study and test. Discover for yourself the explanation of its success.

*Extensive line of both standard and special designs in addition to cradle-base motor here described.*

1/8 1/6 1/4 1/3 1/2 3/4 1 1 1/2 2 3

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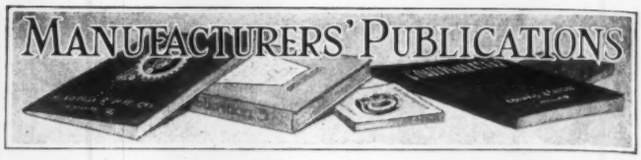
DAYTON · OHIO · · · U·S·A

Leland Motors


BEARINGS—Engineering information on the application of ball bearings to radial vane type hydraulic pumps is included in Bulletin No. 202 FE of New Departure Mfg. Co., Bristol, Conn.

BEARINGS—Tyson Roller Bearing Corp., Massillon, O., has published antifriction bearing recommendations and engineering data for application of cageless tapered roller bearings in mine cars and quarry cars.

CONTROLS (ELECTRICAL)—General Electric Co., Schenectady, N. Y., has issued catalog insert GEA-1761 on its line of motor starting switches for fractional horsepower motors which provide thermal overload protection.

CONTROLS (ELECTRICAL)—Combination linestarters for squirrel cage and wound rotor induction motors are described in a recent catalog insert of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

DRIVES—Falk-Rawson four-duty couplings which start, couple, cushion and limit the load are described in bulletin No. 500 prepared by Falk Corp., Milwaukee. The couplings operate automatically by centrifugal force.

DRIVES—Spiral bevel gear reducers and spiral bevel gears are covered in a new 48-page catalog prepared by D. O. James Mfg. Co., Chicago, which gives complete information as to sizes, dimensions, horsepower ratings and prices. Cross sectional drawings, application photographs and descriptions also are included.

ELECTRONIC EQUIPMENT—Photoelectric relays manufactured by General Electric Co., Schenectady, N. Y., are covered in a recent leaflet of the company.

FINISHES—The metallizing process by which metal is sprayed in a molten condition on to any solid base, its applications, advantages and accessory equipment are covered in a recent 20-page booklet issued by International Metallizing association, New York. The type of metals used, objects coated and purpose of the coating are included.

MATERIALS (COMPOSITION)—Bakelite Corp., New York, has prepared leaflet No. 34 on its new "Impact" molding material, said to have superior mechanical characteristics.

MOTORS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has prepared an illustrated booklet which gives complete information on Thermoguard motors and their applications. These self-protected motors may be used on all applications.

TRANSFORMERS—A leaflet describing a new line of

small transformers for bell ringing, ultra-violet lighting, furnace control, etc., is being distributed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

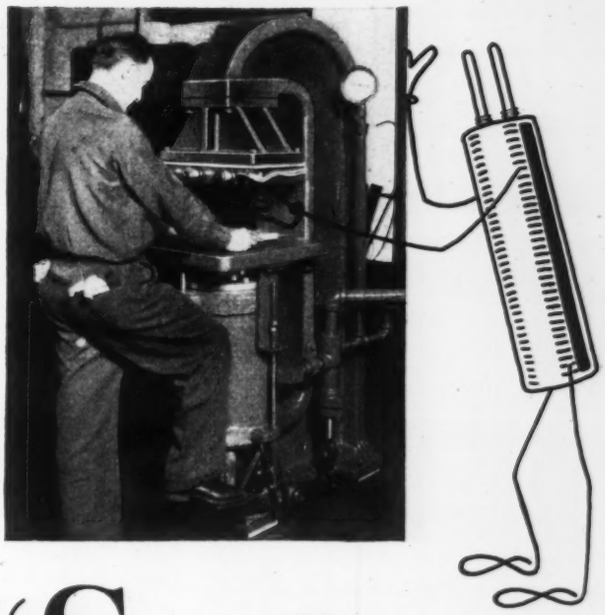
VALVES—B. F. Goodrich Rubber Co., Akron, O., has prepared folder 9787 on its new Vulcalock valve. This valve may be lined with any of the standard Goodrich Acidseal rubber compounds, hard or soft, depending on conditions of service. It will resist deterioration which might be brought about by corrosive or abrasive substances.

WELDED PARTS AND EQUIPMENT—A survey of the correct procedure for welding chromium steels is given in a comprehensive article entitled "Welding Corrosion Resisting Steels," in the June, 1933, issue of *Oxy-Acetylene Tips*, published by Linde Air Products, New York.

## Research Publications

*The Effect of Varying Compression Ratio and Inlet Temperature on Engine Performance*, by G. W. Hobbs and M. L. Surls. The problem of improving engine performance today runs in two directions, one of which is to develop a new fuel that will not detonate when used in the existing type of engine with high compression. The other is to design an entirely new engine that will give improved performance with existing fuels. Exact knowledge of the effects of certain variables on operations of present day engines should be the first step in an attempt to improve their performance. This thought has prompted the present investigation in which the effect of such variables as air-fuel ratio, spark setting, temperature of intake air, etc., on engine performance over a considerable range of compression ratios has been recorded. Published as bulletin No. 50 by Michigan Engineering Experiment Station, Michigan State College, East Lansing, Mich. 13 pp.

*Creep and Structural Stability of Nickel-Chromium-Iron Alloys at High Temperatures.* The problem of the research and testing laboratory is to secure data on the high temperature strength of metals, which are sufficiently dependable for the use of the engineer. This problem is by no means a simple one, because the strength of metals in service involves a time factor. That is, a metal which appears to be sufficiently strong and rigid when tested by the rapid application of a certain load may deform or fail if loaded to a far less degree and allowed to remain under this load for a long period of time. The deformation that results from loading for a long period of time is called "creep." The measurement of "creep" of metals at elevated temperatures is the nearest approach to a satisfactory test by which materials may be selected for service conditions. Published as Research Paper 57 by bureau of standards. Available through Superintendent of Documents, Government Printing office, Washington.

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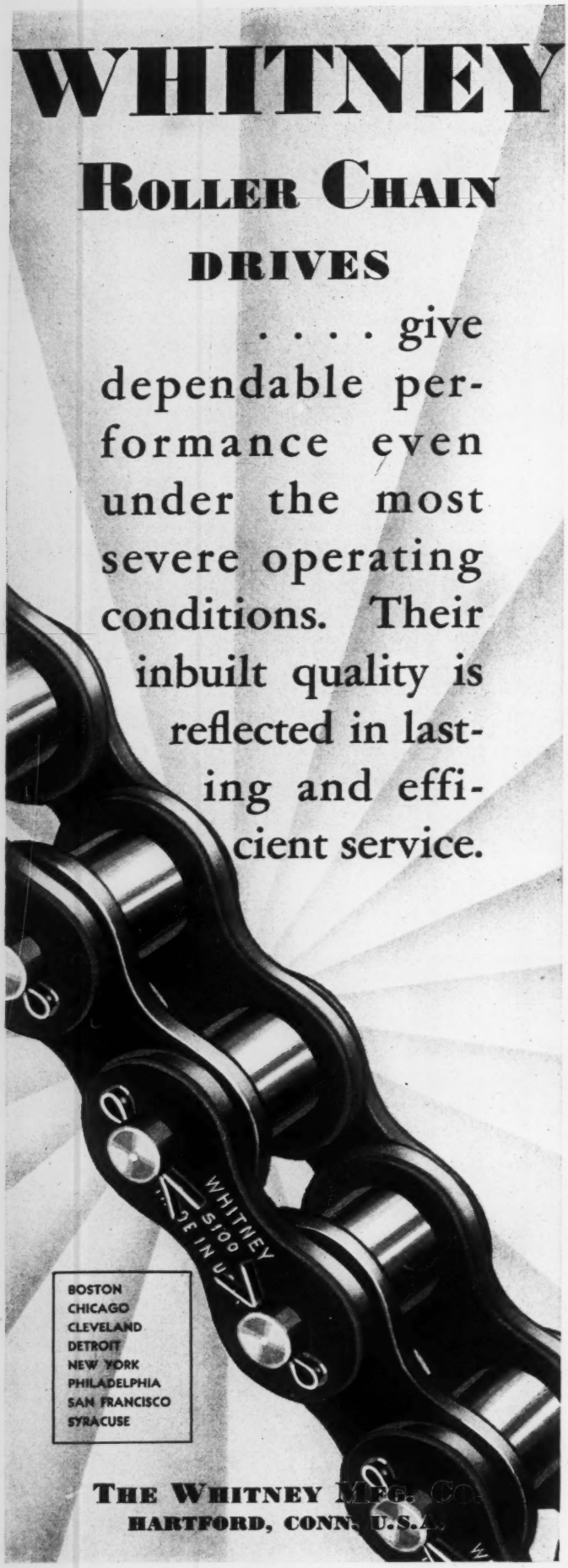


# Machine Creates Leisure, Wealth, Culture

(*Concluded from Page* 33)

hand-labor, with its "ennobling influences" persists, the majorities are dangerously close to slavery yet. What the intelligentsia seems to want are the "good old days" when the cobbler worked at his bench 16 hours, ate three meals at his work, lived in a stuffy, airless room and enjoyed his "creative freedom." To some critics, welding a sledge hammer 10 to 12 hours a day in a sooty blacksmith shop is ennobling; but to sit on a comfortable seat in a well-heated and ventilated factory manipulating a delicate lever to operate a trip hammer is debasing.

### More Workers Added to Payrolls

In 1928, he pointed out, there were 1,250,000 fewer men in factories than in 1923, and '28 was one of our busiest years. This does not mean that fewer men were at work, although popular opinion has placed that construction on it. It means only that fewer men were at work in factories and fewer men were tending machines, for during the same period we added directly more than 2,000,000 men and women to our payrolls, who were working at new trades and new enterprises which the higher development of the machine had made possible.

British statistics reveal that the total number employed in industry (and all trades affected by the invention of new and modern machines are included) increased during the thirty years between 1881 and 1911 from 6,373,000 persons to 9,468,000, a rate of 48 per cent. Population of England for the same period increased only 38 per cent.

The machine plus brains equals goods, comforts and wealth. This formula increased factory production in America almost 60 per cent between 1900 and 1925, holding true on the railroads, in the mines and on the farms. The perfection of the tool has measured the speed of man's upward journey from the stone age to the present. Considering all industries in the United States, 71 workers in 1925 could produce as much as 109 in 1900, while working from 5 to 10 per cent less time. Here, asserted Mr. Thomas, is the crowning glory of the machine. Let us be quick to admit that the productive output per worker has increased, that fewer men in a given field can do more work. But having admitted this much, there is no use being stampeded by self-styled philosophers. To reduce the hours a man works in this world always has been considered a desirable thing to do. If the machine enables him to do more work in less time, it proves itself humane, not a menace.

# Inertia, Vacuum, Used in Automatic Controls

(*Concluded from Page* 17)

car speed through a centrifugal governor and engine load requirements.

A short time ago Cadillac introduced the sychro-mesh transmission and utilized a hydraulic dash pot timing device to determine the dwell of engagement for the synchronizing cones. It also automatically compensates for viscosity changes in the oil. The device, Fig. 10, is located in the synchronizer yoke with the roller at the upper end engaging a cam slot in the high-second speed shifting rod. It also will be noted that the yoke is supported eccentric fashion with an outside adjustment.

### Bimetal Controls Operation

An interesting hydraulic principle is used in the Houdaille shock absorber, Fig. 1. In the first place a coil of thermostic metal is anchored to the calibrating screw at the right and at the left to a rotating plug having a flat portion milled off to present a sharp cutoff edge to the narrow slit orifice in the surrounding spool. Oil from the high pressure chamber of this vane-type shock absorber flows into an annular space in the spool, then through that portion of the slot that is opened by the rotating plug. It then follows along the milled-off portion to a return passage below the plug. The thermostatic coil with temperature changes varies the length of slot that is open to the flow of oil, being greatest of course when the oil is most viscous. The coil also acts as a spring. Rapid flow causes an impact on the flat of the plug and in this manner the resistance of the shock absorber is built up automatically the resultant plug rotation against the coil spring pressure and cut-off action. The greater the surge of oil, the greater is the reduction in orifice area.

There has been few applications of torque reaction to automatic car control, although patent literature abounds with it. We are now on the verge of its practical application, especially in the newer transmission developments. The Mono-Drive utilizes it in a unique way to effect high speed engagement. We shall however see the use of mechanical or hydraulic means to sense variations in torque.

There are many types of machinery where a secondary function or reaction can be harnessed and utilized in their operation and control. It is hoped that some of the automotive devices described will suggest to the reader a somewhat similar design or adaptation in his own particular field of design. All forces and types of motivation can be found and if we search for them they can be put to good use.


Add this organization to your own

by applying WAGNER MOTORS to your products

When you design a motor driven product and program the expenditure of time, effort and money to develop sales for that product, you naturally give consideration to the staying qualities of the manufacturer supplying the motor. Perhaps you investigate the manufacturer's financial condition. All of this is good business.

Past performance is about the only yard stick by which you can measure the staying qualities of any manufacturer.

Wagner offers its record of forty years' service to the electrical industry as evidence of its staying qualities. In those forty years Wagner has built a national reputation and acceptance of its products. Wagner offers the cooperation of a nationwide organization, 26 branch offices, service stations and motor warehouses.

*Illustrations:*
The huge Wagner plant at St. Louis, and the location of Wagner's 26 Branch Offices

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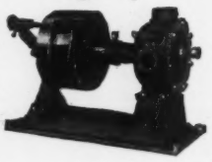
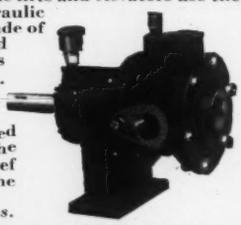


For the actuation of machine tool movements and the operation of hydraulic lifts and elevators use the Viking Hydraulic Oil Pump. Made of laboratory - tested metals in capacities of 5 to 45 G.P.M.



For coolant purposes use the Viking Coolant Pump. Capacities of 5, 10, 15, 20 and 35 G.P.M. Ports are tapped and plugged to permit changing the direction of rotation. Built-in relief rotor to act as relief valve when the oil line is shut off.

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***MACHINE DESIGN*** is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

# Business and Sales Briefs

MacDERMID INC., Waterbury, Conn., now is affiliated with Udylite Process Co., Detroit, as sales agent for all Udylite supplies and materials. Complete stocks of materials and supplies are carried at the MacDermid plant in Waterbury.

* * *

Clark-Wilcox Co., 790 Albany street, Boston, has been made exclusive representative covering the New England states for Homestead Valve Mfg. Co. Inc., Coraopolis, Pa.

* * *

Union Drawn Steel Co., Beaver Falls, Pa., has appointed John C. Malone, 501 East Ridge road, Gary, Ind., its representative in Indiana.

* * *

Paul Seeger, former banker of Kenosha, Wis., has been appointed general sales manager of Elra Mfg. Co., Kenosha, manufacturer of a new type of heating unit.

* * *

Frank L. Shants has been appointed manager of sales in the Philadelphia office for Lukens Steel Co., Coatesville, Pa. He formerly was assistant manager in the office.

* * *

L. W. Sheehy has been appointed manufacturer's representative by Ex-Cell-O Aircraft & Tool Corp., Detroit, in the New England territory with headquarters at 51 Washington avenue, Cranston, R. I.

* * *

Manganese Steel Forge Co., Philadelphia, has acquired the entire business and assets of Audubon Wire Cloth Co. Inc., wire cloth and wire products manufacturer. L. W. Jones is president of the new organization which will operate as a wholly owned subsidiary of the Manganese Steel Forge Co.

* * *

W. F. Kurfess, formerly manager of the mill department, Joseph T. Ryerson & Son Inc., Chicago, has been appointed assistant vice president of the company. M. J. Hartigan succeeds Mr. Kurfess as manager of the mill department. R. B. Wilson, formerly sales manager of the St. Louis plant of the company, has been made manager of the plant.

* * *

Harry S. Ransom has been recently appointed special sales representative in the Pittsburgh and Eastern Ohio districts for Ft. Pitt Steel Casting Co., McKeesport, Pa.; Cleveland Hardware & Forging Co., Cleveland, maker of drop forgings, die castings and pipe threading protectors; and Calorizing Co., Pittsburgh, maker of chrome nickel alloys.

* * *

E. F. Houghton & Co., Philadelphia, has announced the following changes in personnel: Major A. E. Carpenter is now general manager; George W. Pressell, assistant general manager and director of sales; Dr. R. H. Patch, treasurer; and A. E. Carpenter III, secretary. Louis E. Murphy continues as president. George S. Rogers, formerly assistant general sales manager in charge of the St. Louis and Chicago offices has been appointed general sales manager with headquarters in Philadelphia.

* * *

The eleven companies constituting the Insulation Statistical Bureau have organized a technical committee to deal with technical phases of the manufacture and use of fiber insulating boards. The committee consists of E. C. Lloyd, chief engineer, Armstrong Cork & Insulation Co.; R. T. Miller, chief engineer, Masonite Corp.; E. W. Morrill, assistant to general sales manager, Insulite Co.; C. K. Roos, manager research department, United States Gypsum Co.; and T . B. Munroe, Celotex Co., Chairman.


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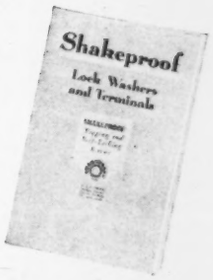


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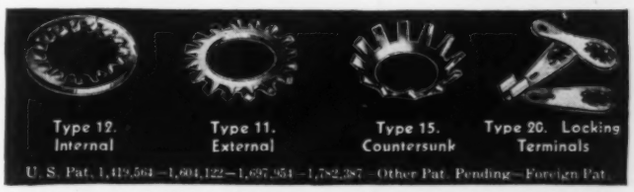


U. S. Pat. 1,419,564—1,604,122—1,697,954—1,782,287—Other Pat. Pending—Foreign Pat.